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ABSTRACT

Data from 20 years (1970-90) of the National Assessment of Educational Progress (NAEP) are summarized. The NAEP represents the nation's only ongoing assessment of the academic achievement of American students. Its assessments of educational achievement of students in grades 4, 8, and 12 are presented as "The Nation's Report Card". Chapter 1 of this report contains information about the students' competency in subject matter across the curriculum and their ability to use their minds well. Chapters 2 and 3 include information about the trends across time related to the performance of elementary school, middle school, and secondary school students in higher-order reasoning, problem solving, and communication skills as well as information about the academic achievement of minority students. Chapter 4 summarizes information about background variables related to education. In general, the data indicate that the educational performance of U.S. students is low and not improving. It is estimated that more than half of the nation's elementary through high school students are unable to demonstrate competency in challenging subject matter in English, mathematics, science, history, and geography. Fewer than half of all U.S. students appear to be able to use their minds well. Although considerable progress has been made in closing the performance gaps among different racial/ethnic and gender groups, the gaps still remain too large to meet the nation's objective of close parallels between the performance of minority students and the student population as a whole. Much that research has identified as effective in improving education is still not being implemented in the nation's schools. Nineteen tables and five figures summarize NAEP data. (SLD)

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AMERICA'S CHALLENGE:

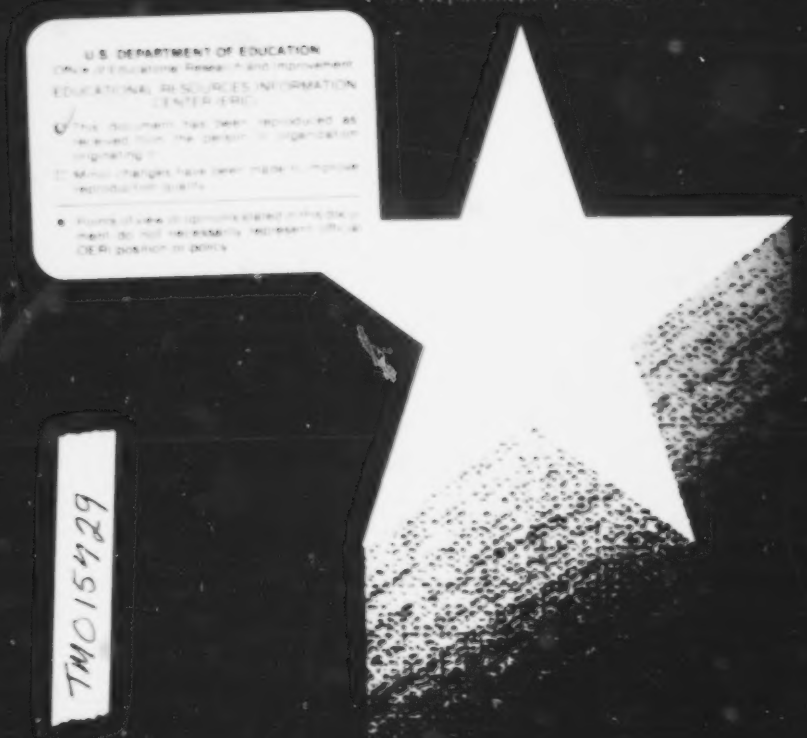
ACCELERATING ACADEMIC ACHIEVEMENT

A Summary Of Findings From 20 Years Of NAEP

A National Goal for the 90s:
By the year 2000, every school in America will ensure that all students learn to use their minds well...

Prepared by Educational Testing Service
under a grant from the National Center for Education Statistics

Office of Educational Research and Improvement
U.S. Department of Education



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THE NATION'S REPORT CARD
naep

What is The Nation's Report Card?

The Nation's Report Card, the National Assessment of Educational Progress (NAEP) is the only nationally representative and continuing assessment of what America's students know and can do in various subject areas. Since 1969-70, assessments have been conducted periodically in reading, mathematics, science, writing, history, geography, and other fields. By making objective information on student performance available to policy makers at the national, state, and local levels, NAEP is an integral part of our nation's evaluation of the condition and progress of education. Only information related to academic achievement is collected under this program. NAEP guarantees the privacy of individual students and their families.

NAEP is a congressionally mandated project of the National Center for Education Statistics, the U. S. Department of Education. The Commissioner of Education Statistics is responsible, by law, for carrying out the NAEP project through competitive awards to qualified organizations. NAEP reports directly to the Commissioner, who is also responsible for providing continuing reviews, including validation studies and solicitation of public comment, on NAEP's conduct and usefulness.

In the 1988 Amendments, Congress created the National Assessment Governing Board (NAGB) to formulate the policy guidelines for NAEP. The board is responsible for selecting the subject areas to be assessed, which may include adding to those specified by Congress; identifying appropriate achievement goals for each age and grade; developing assessment objectives; developing test specifications; designing the assessment methodology; developing guidelines and standards for data analysis and for reporting and disseminating results; developing standards and procedures for interstate, regional, and national comparisons; improving the form and use of the National Assessment; and ensuring that all items selected for use in the National Assessment are free from racial, cultural, gender, or regional bias.

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SEPTEMBER 1990

THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

Prepared by Educational Testing Service
under a grant from the National Center for Education Statistics

Office of Educational Research and Improvement • U.S. Department of Education

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Foreword

The National Assessment of Educational Progress (NAEP) is a Congressionally-mandated project in the National Center for Education Statistics that measures scholastic achievement of elementary, middle and high school students. Over the past 20 years, NAEP has generated more than 200 reports spanning eleven instructional areas. It is the nation's only ongoing, comparable, and representative assessment of what American students know and can do. For this reason, the NAEP data are a unique resource to monitor student achievement in the United States.

Most of the data in this report show that our present education performance is low and not improving. The achievement of 17-year-olds in reading, mathematics, science, history, and civics represents only modest performance. According to the report, large majorities of these students — 81 percent to 96 percent — have rudimentary interpretative skills; they can make generalizations, solve one-step problems, and understand basic science. Only 5 percent to 8 percent of our 17-year-olds, however, demonstrate those skills we usually associate with the ability to function in more demanding jobs in the workplace or the capability to do college work. These students can carry out multiple-step problems, synthesize, draw conclusions, and interpret.

Over the years reported here, the achievement of minority students has improved, with the greatest gains in reading. Sadly the gaps between minority and white students are still large and the performance of white students has remained stagnant over nearly two decades.

NAEP data enable us to compare and contrast what has been learned about successful practice with what is actually happening in America's classrooms. Research shows that student academic performance is likely to be greater when pupils work hard, when parents are actively involved in their children's education, and when teachers and school administrators incorporate research tested improvements in the classroom. Yet this report, *America's Challenge: Accelerating Academic Achievement, A Summary of Findings from 20 Years of NAEP*, shows that these things are not typically happening. Time devoted to core subject areas is limited despite research showing the importance of high quality time for instruction. Homework is often minimal or nonexistent. Most classroom work is dominated by passive learning activities that feature teacher- and textbook-presented information despite research findings indicating that these techniques are not the most effective. Moreover, although parents are our children's first and most effective teachers, large proportions of students are not reading outside of school, are spending excessive hours watching television, and are spending little time on homework.

All of the trend data reported here were gathered before National Education Goals had been set by the President and Governors. Consequently, they do not reflect any of our nation's recently redoubled efforts to increase education performance. The next National Assessment reports, on results of testing in mathematics, reading, and science conducted this past spring, are scheduled for release in 1991. A special feature of the 1990 testing was that 37 states, the District of Columbia, and two territories participated in the first Trial State Assessment. Findings on mathematics achievement among eighth graders will be released June 6, 1991. Such State-level results promise to make NAEP more useful for policy makers and the public than ever before.

Emerson J. Elliott
Acting Commissioner of Education Statistics

This report is based primarily on the following NAEP reports:

Reading and Writing (based on the 1988 assessments):

Arthur N. Applebee, Judith A. Langer, Lynn B. Jenkins, Ina V.S. Mullis, and Mary A. Foertsch. *Learning to Write in Our Nation's Schools: Instruction and Achievement in 1988 at Grades 4, 8, and 12* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

Arthur N. Applebee, Judith A. Langer, Ina V.S. Mullis, and Lynn B. Jenkins. *The Writing Report Card, 1984 to 1988: Findings from The Nation's Report Card* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

Judith A. Langer, Arthur N. Applebee, Ina V.S. Mullis, and Mary A. Foertsch. *Learning to Read in Our Nation's Schools: Instruction and Achievement in 1988 at Grades 4, 8, and 12* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

Ina V.S. Mullis and Lynn B. Jenkins. *The Reading Report Card, 1971 to 1988: Findings from The Nation's Report Card* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

U.S. History, Civics, and Geography (based on the 1988 assessments):

Russell Allen, Norman Bettis, Dana Kurfman, Walter MacDonald, Ina V.S. Mullis, and Christopher Salter, with the collaboration of Mary A. Foertsch, Lynn B. Jenkins, and Marianne Kennedy. *The Geography Learning of High-school Seniors* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

Lee Anderson, Lynn B. Jenkins, James Leming, Walter MacDonald, Ina V.S. Mullis, Mary Jane Turner, Judith S. Wooster. *The Civics Report Card: Trends in Achievement from 1976 to 1988 at Ages 13 and 17; Achievement in 1988 at Grades 4, 8, and 12* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

David C. Hammack, Michael Hartoonian, John Howe, Lynn B. Jenkins, Linda S. Levstik, Walter B. MacDonald, Ina V.S. Mullis, and Eugene Owen. *The U.S. History Report Card: The Achievement of Fourth-, Eighth-, and Twelfth-grade Students in 1988 and Trends from 1986 to 1988 in the Factual Knowledge of High-school Juniors* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1990)

Mathematics and Science (based on the 1986 assessments):

John A. Dossey, Ina V.S. Mullis, Mary M. Lindquist, and Donald L. Chambers. *The Mathematics Report Card: Are We Measuring Up? Trends and Achievement Based on the 1986 National Assessment* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1988)

Ina V.S. Mullis and Lynn B. Jenkins, with an Interpretive Overview by Richard Berry, Audrey Champagne, John Penick, Senta Raizen, Iris Weiss, and Wayne Welch. *The Science Report Card: Elements of Risk and Recovery* (Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service, 1988)

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Many individuals generously gave their ideas, talents, time, and energy to NAEP's 1986 and 1988 assessments and to the associated reports that provide the basis for this summary document. Their contributions deserve to be recognized here. The authors of this report also express their deepest thanks to the many individuals from the U.S. Department of Education, Educational Testing Service, and other organizations and agencies who helped bring the manuscript to its final form.

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Introduction

During the 1980s, a number of national and international achievement surveys have warned that there is something seriously wrong with elementary and secondary school systems in the United States. Despite these alarming reports, all pointing to similar negative conclusions and indicating inadequate preparation of students, there seems to be a certain degree of apathy on the part of the American public about this problem. Some of the lack of general concern may result from overly rosy reports of local successes that may be creating a false sense of security.[1] Although many Americans may recognize poor education as a national problem, they also often seem to think that their own children are receiving a satisfactory education and give high grades to the public schools in their own communities.[2]

The truth may be that relatively few children are receiving the education they need for life in the 21st century. There is considerable evidence that large numbers of students graduate from school lacking the skills needed by employers and expected by college professors. As diagnosed in one study, these young people are not at-risk, yet they are not workforce ready. For the at-risk populations, the mismatch between workplace needs and workforce skills is even greater.[3] According to a recent report from the National Alliance of Business:

> *It is estimated that by 1995, 14 million Americans will be unprepared for the jobs that are available. Many companies are concerned that they will not be able to find employees who can even read or do simple arithmetic. Business Week reports $210 billion is spent annually by American companies to train and upgrade their workers, which exceeds the $195 billion annual expenditure for public elementary and secondary education. Because $20 billion of that private sector budget is already earmarked for remedial education (a total that can be expected to increase), companies are forced to pay twice for education—first through taxes and then for internal remedial programs—for what the schools could not or did not achieve.*[4]

[1] John J. Cannell, *Nationally Normed Elementary Achievement Testing in America's Public Schools: How All Fifty States Are Above the National Average* (Daniels, WV: Friends of Education, 1987).

[2] Stanley M. Elam and Alec M. Gallup, "The 21st Annual Gallup Poll of the Public's Attitudes Toward the Public Schools," *Phi Delta Kappan* (September 1989), p. 50.

[3] National Alliance of Business, *The Fourth R: Workforce Readiness* (New York, NY: 1987).

[4] National Alliance of Business, *The Business Roundtable Participation Guide: A Primer for Business on Education* (New York, NY: 1990).

Further, American colleges have reported a 10- to 30-percent rise in demand over the past several years for remedial course work for incoming freshman, and surveys indicate that 75 percent of all college faculty feel that entering students lack basic skills.[1]

The problem, however, is much larger than simply a lack of basic skills. Looking toward the year 2000, the fastest-growing occupations require employees to have much higher math, language, and reasoning capabilities than do current occupations.[2] Further, we live in a world economy, but the United States is losing its ability to compete in an international marketplace, even in "homegrown" areas such as automobile manufacturing and television technology.

In addition to economic concerns that directly affect our standard of living and the American way of life, there are also concerns about how well students are prepared to solve problems related to the future health of our country and planet. Our daily lives are influenced by the rise and fall of the stock market, the size of the government budget and budget deficit, the balance of trade with other countries, and international monetary policy. Debates are carried on about world-wide environmental issues, including depletion of the ozone layer, acid rain, and global deforestation. Unfortunately, there is growing evidence that the typical American high-school student does not know enough to appreciate what these issues or debates are all about, let alone to participate creatively and effectively in making decisions about the salient issues.

As part of a sense of growing urgency among political and business leaders about the need to improve levels of American education, the President and governors met in September 1989 at the historic Education Summit in Charlottesville, Virginia. One result of the summit was a set of national education goals designed to better position our country for active participation in the world's affairs in the 21st century. Subsequently highlighted in the State of the Union address, and formally adopted by the President and governors in February 1990, these six goals focus on ensuring that children start school ready to learn, raising high-school graduation rates to 90 percent, increasing levels of educational achievement, promoting science and mathematics achievement as well as literacy and lifelong learning, and freeing schools of drugs and violence.

[1] Ernest L. Boyer, College: The Undergraduate Experience in America (New York, NY: Harper and Row, 1987).

[2] Hudson Institute, Workforce 2000: Work and Workers for the 21st Century, Indianapolis, IN, 1987).

One goal in particular is targeted toward increasing students educational achievement levels, ensuring that they learn to use their minds well, and preparing them for responsible citizenship. This overarching goal for American education, and its accompanying objectives, are as follows.

National Goal: *By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.*

Objectives:

The academic performance of elementary and secondary students will increase significantly in every quartile, and the distribution of minority students in each level will more closely reflect the student population as a whole.

The percentage of students who demonstrate the ability to reason, solve problems, apply knowledge, and write and communicate effectively will increase substantially.

All students will be involved in activities that promote and demonstrate good citizenship, community service, and personal responsibility.

The percentage of students who are competent in more than one language will substantially increase.

All students will be knowledgeable about the diverse cultural heritage of this nation and about the world community.

This report provides information that can be useful in describing where we currently stand as a nation in relation to this national education goal and its accompanying objectives. The National Assessment of Educational Progress (NAEP) regularly conducts assessments of the educational achievement of fourth, eighth, and twelfth graders attending public and private schools and presents the results in the form of "The Nation's Report Card." To describe the current status of student achievement and provide a context for estimating how far we are from our national goal, the results from NAEP reading, writing, mathematics, science, U.S. history, civics, and geography assessments conducted in 1986 and 1988 are summarized and presented together in this report. Trend results from the past 20 years of NAEP assessments also are presented to describe changes that have occurred in student achievement levels during the last two decades.

Taken in total, the results of The Nation's Report Card provide evidence that we have a daunting challenge before us if we are to reach our national student achievement goal by the 21st century.

- Students' current achievement levels are far below those that might indicate competency in challenging subject matter in English, mathematics, science, history and geography.
  - Students can read at a surface level, getting the gist of material, but they do not read analytically or perform well on challenging reading assignments.
  - Small proportions of students write well enough to accomplish the purposes of different writing tasks; most do not communicate effectively.
  - Students' grasp of the four basic arithmetic operations and beginning problem-solving is far from universal in elementary and junior high school; by the time that students near high-school graduation, half cannot handle moderately challenging material.
  - Only small proportions of students appear to develop specialized knowledge needed to address science-based problems, and the pattern of falling behind begins in elementary school.

- Students are familiar with events that have shaped American history, but they do not appear to understand the significance and connections of those events.

- Similarly, students demonstrate an uneven understanding of the Constitution and American government and politics; their knowledge of the Bill of Rights is limited.

- Trends across the past 20 years suggest that, although some ground lost in the 1970s may have been regained in the 1980s, overall achievement levels are little different entering the 1990s than they were two decades earlier.

- Very few students demonstrate that they can use their minds well. In recent assessments, more students appear to be gaining basic skills, yet fewer are demonstrating a grasp of higher-level applications of those skills.

- Despite progress in narrowing the gaps, the differences in performance between White students and their minority counterparts remain unacceptably large. Little progress has been made in reducing gender performance gaps favoring males in mathematics and science and females in writing.

- Large proportions of students, even including those in academic high-school programs, are not enrolled in challenging mathematics and science coursework. Instructional time is particularly low for science in elementary schools, writing in middle schools, and geography in high schools.

- Across the past 20 years, little seems to have changed in how students are taught. Despite much research suggesting better alternatives, classrooms still appear to be dominated by textbooks, teacher lectures, and short-answer activity sheets.

Chapter One of this report presents NAEP findings pertaining to students' competency in challenging subject matter across the curriculum areas and to their ability to use their minds well. Chapters Two and Three include information about trends across time related to the performance of elementary, middle, and secondary school students. Changes across time are described in students' higher-order reasoning competencies, problem-solving abilities, and communication skills, as well as in the academic achievement of minority students compared to the nation as a whole.

NAEP also collects information about an extensive array of background variables related to education. In Chapter Four, some of this information is summarized in the context of research about education, suggesting potential areas where schools and parents might focus efforts to improve educational achievement.

1 What is the Current Level of Student Achievement?

National Goal: *By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.*

Objective: *All students will be involved in activities that promote and demonstrate good citizenship . . . (and) will be knowledgeable about the diverse cultural heritage of this nation and about the world community.*

If, by the year 2000, fourth, eighth, and twelfth graders are to leave school having demonstrated competency in English, mathematics, science, history, and geography, it is useful to examine the results from NAEP assessments in these curriculum areas to ascertain the levels of competency shown by students as we enter the 1990s. In addition, if students are to learn to use their minds well, it is informative to look at NAEP results from the perspective of students' achievement in the area of higher-order thinking skills. By gauging where we are today, we can better judge how far we need to progress during the next decade.

The NAEP data provide several avenues for describing student achievement in each curriculum area, including results from specific questions and summaries of achievement across questions. For reading, mathematics, science, U.S. history, and civics, NAEP has summarized student performance across questions on 0 to 500 proficiency scales designed to provide a basis for describing overall student achievement in each curriculum area.

To "anchor" or give meaning to the results, student performance is characterized at four or five levels along the proficiency scales (i.e., 150, 200, 250, 300, and 350) and the percentages of students reaching each level are presented.* To characterize levels of student performance, NAEP began by empirically identifying items that discriminated between adjacent pairs of proficiency levels. These items were grouped for each of the levels, and subject-area experts were then asked to interpret the items and describe what students at each level knew and could do compared to students at the next lower level.

The discussions on student achievement in English, mathematics, science, U.S. history, and civics will rely on the scale-anchored results when they are available. Results based on other types of analyses also are included.

English: Reading and Writing

Reading. In 1988, students' reading achievement was measured from several perspectives. The proficiency levels of 9-, 13-, and 17-year-olds on the NAEP reading scale are shown in Table 1.1. The results for the three age levels have been placed on a common scale to track growth across the school years, as well as trends for the three age groups assessed. The expectation is that students' performance will improve as they get older — and it does. In 1988, students showed tremendous growth from age 9 to age 17 in the types of reading tasks they were able to perform.

By age 9, virtually all students displayed rudimentary reading skills and strategies, characterized by the ability to perform relatively uncomplicated, discrete reading tasks successfully. However, at the other extreme, very few students, even those in high school (5 percent) reached the highest level of reading proficiency, reflecting their difficulty in comprehending passages that are more lengthy and complex or that deal with specialized subject matter.

The 0-500 NAEP scales were developed using Item Response Theory (IRT) technology. The numerical values on each scale were established on the basis of student performance in the 1984 reading, 1986 mathematics, 1986 science, 1988 U.S. history, and 1988 civics assessments. In theory, proficiency levels above 450 or below 150 on the 500 scales could have been defined; however, so few students in the assessment performed at the extreme ends of the scale that it was not practical to do so. Each scale was set to span the range of student performance across all three grades in that subject-area assessment and to have a mean of 250.5 and a standard deviation of 50. While the scales for different subject areas are expressed in the same numerical units, they are not comparable. Like all other scales developed using IRT technology, the NAEP scales cannot be described in absolute terms. Thus, for example, one cannot say how much learning in mathematics equals how much learning in science and reading. It should also be noted that the terms proficiency and achievement refer specifically to performance on the items on the NAEP assessment.

TABLE 1.1

Percentages of Students Performing at or above Reading Proficiency Levels, 1988: Ages 9, 13, and 17

Level	Description	Age 9	Age 13	Age 17
350	Can synthesize and learn from specialized reading materials	0.0 (0.0)	0.2 (0.1)	4.8 (0.4)
300	Can find, understand, summarize, and explain relatively complicated information	1.2 (0.2)	10.6 (0.7)	41.8 (1.3)
250	Can search for specific information, interrelate ideas, and make generalizations	17.0 (0.9)	58.0 (1.1)	86.2 (0.7)
200	Can comprehend specific or sequentially related information	62.5 (1.2)	95.1 (0.5)	98.9 (0.2)
150	Can carry out simple, discrete reading tasks	93.0 (0.6)	99.8 (0.1)	100.0 (0.0)

Standard errors are presented in parentheses. Those designated as 0.0 are less than .05. It can be said with 95 percent confidence that the percent is within ± 2 standard errors of the estimated value.

Although almost all 9-year-olds (93 percent) demonstrated rudimentary reading skills, less than two-thirds displayed the reading skills necessary to comprehend specific or sequentially related information. Nearly all 13-year-olds (95 percent) displayed basic reading skills, but only 58 percent reached the intermediate proficiency level defined by NAEP, which entailed the ability to search for specific information in passages, interrelate ideas presented in text, and make generalizations. Eleven percent of the 13-year-olds (primarily seventh and eighth graders) were consistently able to find, understand, summarize, and explain relatively complicated information. Eighth graders displayed similar levels of reading comprehension in the National Education Longitudinal Survey (NELS) of 1988.* Eighty-six percent of

*Anne Hafner, Steven Ingels, Barbara Schneider, and David Stevenson, *A Profile of the American Eighth Grader: NELS:88 Student Descriptive Summary* (Washington, DC: National Center for Education Statistics, 1990).

the students at grade 8 showed basic proficiency, which entailed reproducing detail or the author's main thought — skills associated with Levels 200 and 250 on the NAEP reading scale. Thirty-four percent of the eighth graders were able to make inferences beyond the author's main thought, to summarize, or to make generalizations — skills and strategies related to Levels 250 and 300 on the NAEP scale.

At age 17, 99 percent of the students appeared to have the reading skills needed to comprehend specific and sequentially related information, and 86 percent reached the intermediate proficiency level. However, fewer than half were consistently able to understand, summarize, and explain relatively complicated information.

A somewhat different NAEP reading assessment of fourth, eighth, and twelfth graders, also conducted in 1988, focused on two aspects of reading comprehension: the ability to construct meaning from text, and the ability to examine that meaning by extending, elaborating, and critically judging the information contained in a passage. Students were asked to read a variety of literary and informational passages and then to answer a series of multiple-choice and open-ended questions. Some multiple-choice questions asked them to identify the overall message or author's purpose, while other questions asked them to identify specific information, such as the elements in a story plot. Several open-ended questions required students to extend the meaning they initially developed from the text — for example, by discussing the moral of a story or by describing the nature of certain events.

At all three grade levels, nearly three-quarters of the students, on average, responded correctly to questions about specific information contained in both literary and informational passages. Half to two-thirds responded correctly to questions about the overall message or "gist" of the passages, although students appeared to find it more difficult to develop an understanding of informational passages than of literary passages.

Students were much less successful at examining and extending the meaning of various texts. Only small percentages of students gave elaborated responses to open-ended questions that asked them to extend meaning. In fact, across all three grade levels, no more than 13 percent of the responses to the open-ended questions were rated as elaborated. Thus, it appears that students can comprehend specific parts of text, but have trouble understanding the main topic of the text. Further, they seem to have substantial difficulty in articulating evidence for whatever understanding they have reached.

In summary, taking the results of both the age- and grade-level reading assessments into account, it appears that most students develop the ability to read for surface understanding as they progress through the school years. That is, they can identify specific information and the "gist" of the material. Yet when either the material or the reading tasks themselves become more challenging, as suggested in our national goal, far fewer students display competency. In particular, they appear to have considerable difficulty analyzing and synthesizing what they have read.

Writing. The results of the 1988 writing assessment of fourth, eighth, and twelfth graders are even more worrisome than the results of the reading assessments. Table 1.2 presents information on the percentages of students who achieved or surpassed the "minimal" and "adequate" levels of writing achievement in their responses to the tasks included in the 1988 writing assessment. Students writing at or above the minimal level displayed some of the elements needed to complete the task, but they did not manage these elements well enough to ensure that the purpose of the task would be achieved. Adequate or better responses included the information and ideas critical to accomplishing the underlying task required by the writing prompt and were considered likely to be effective in achieving the desired purpose.

In the informative writing tasks, fourth graders were asked to report on particular events or phenomena, while eighth and twelfth graders were asked to go beyond straightforward reporting to analyze information and provide generalizations with supporting evidence. Over three-quarters of the students in each grade provided at least minimal responses to these tasks, and nearly half the fourth graders responded adequately to the informative reporting tasks, but many eighth and twelfth graders failed to provide adequate responses to the analytic tasks. For example, their best performance (40 to 45 percent) was on a task that required an explanation of their television viewing habits. On an analytic task that asked students to compare food on the frontier (based on information presented) and today's food (based on their own knowledge), just 16 percent of the students at grade 8 and 27 percent at grade 12 provided an adequate or better response.

Persuasive writing was even more difficult for students. While 65 to 88 percent wrote at least minimal responses to the tasks that asked them to convince others of a point of view, only half to two-thirds of the students provided at least minimal responses to prompts requiring them to refute specific concerns. For example, only 65 percent of the high-school seniors were able to produce a minimal or better response to a task that asked them to

TABLE 1.2

Percentages of Students Performing at or above the Minimal and Adequate Levels on Various Types of Writing Tasks, 1988: Grades 4, 8, and 12

	At or Above the Minimal Level			At or Above the Adequate Level		
Type of Task	Grade 4	Grade 8	Grade 12	Grade 4	Grade 8	Grade 12
INFORMATIVE						
Reporting						
From personal experience						
Report on an animal (L)	78 (1.7)	—	—	47 (2.3)	—	—
From given information						
Describe science project	82 (0.9)	—	—	44 (1.4)	—	—
Analytic						
From personal experience						
Report on TV viewing (L)	—	79 (1.5)	83 (1.7)	—	40 (2.3)	45 (2.5)
Analyze favorite story	—	84 (0.8)	80 (1.1)	—	23 (0.9)	35 (1.2)
From given information						
Compare foods across eras	—	76 (1.1)	83 (1.1)	—	16 (0.9)	27 (1.7)
PERSUASIVE						
Convincing Others						
Capture spaceship (L)	74 (1.8)	—	—	36 (2.5)	—	—
Dissect frogs	—	88 (0.8)	—	—	31 (1.1)	—
Space program funds	—	—	65 (1.1)	—	—	27 (1.1)
Refuting an Opposing View						
Visit radio station	48 (1.2)	62 (1.1)	—	17 (0.9)	27 (1.1)	—
Choose recreation site (L)	—	48 (2.3)	67 (2.2)	—	19 (1.7)	36 (2.2)
State views on bike lane	—	—	69 (1.6)	—	—	24 (1.0)
NARRATIVE						
Imaginative						
Ghost story (L)	88 (1.4)	95 (0.8)	92 (1.0)	17 (1.5)	51 (1.7)	56 (2.6)
Make three wishes	81 (0.9)	—	—	21 (1.3)	—	—
Personal Experience						
Memorable incident	—	80 (1.1)	87 (1.2)	—	38 (1.2)	55 (1.6)

Note: The (L) symbol denotes tasks for which students had twice the usual amount of time to respond — thus, 20 minutes at grade 4 and 30 minutes at grades 8 and 12. Conducted as part of the 1988 assessment, this study showed some improvement in writing performance when students were given more time to complete the tasks. Standard errors are presented in parentheses. It can be said with 95 percent confidence that the percent is within ± 2 standard errors of the estimated value.

write a letter to their senator arguing for or against cutting funds for our country's space program. More than one-third wrote contradictory and unsupported responses, typified by the following example:

> *Dear Senator:*
> *I don't think there should be cuts in the funding but I do think the problems that we have here should be taken care of first. Then you should work on the space program.*

Across the grades, only about one to two-fifths of the students produced adequate responses to the persuasive writing tasks they were given.

In contrast, 80 percent or more of the students at each grade wrote minimal responses to the narrative tasks. Approximately one-fifth of the students at grade 4 and over half the students at grades 8 and 12 wrote stories judged as adequate or better.

In summary, looking across the three grade levels and the different types of writing tasks given in the assessments, one finds that many students have difficulty communicating effectively in writing. No more than 47 percent of the students at any grade level wrote adequate or better responses to the informative tasks, and no more than 36 percent of the students wrote adequate or better responses to the persuasive tasks. Although performance was somewhat better on the narrative writing tasks, no more than 56 percent of the students wrote adequate or better responses.

Mathematics

The proficiency results from NAEP's 1986 mathematics assessment of 9-, 13-, and 17-year-olds are presented in Table 1.3. As in the reading assessment discussed earlier in this chapter, virtually all students at each grade displayed a grasp of simple arithmetic facts; all but a few 13- and 17-year-olds demonstrated beginning skills and understandings of mathematics.

Despite concentrated studies in mathematics in elementary schools, one-quarter of our country's 9-year-olds failed to reach the beginning level defined by NAEP — a level characterized by the ability to add and subtract

TABLE 1.3

Percentages of Students Performing at or above Mathematics Proficiency Levels, 1986: Ages 9, 13, and 17

Level	Description	Age 9	Age 13	Age 17
350	Can solve multi-step problems and use basic algebra	0.0 (0.0)	0.4 (0.1)	6.4 (0.4)
300	Can compute with decimals, fractions, and percents; recognize geometric figures; and solve simple equations; and use moderately complex reasoning	0.6 (0.2)	15.9 (1.0)	51.1 (1.2)
250	Can add, subtract, multiply and divide using whole numbers, and solve one-step problems	20.8 (0.9)	73.1 (1.5)	96.0 (0.4)
200	Can add and subtract two-digit numbers and recognize relationships among coins	73.9 (1.1)	98.5 (0.2)	99.9 (0.1)
150	Knows some basic addition and subtraction facts	97.8 (0.2)	100.0 (0.0)	100.0 (0.0)

Standard errors are presented in parentheses. Those designated as 0.0 are less than .05. It can be said with 95 percent confidence that the percent is within ± 2 standard errors of the estimated value.

two-digit numbers[3]. Only one-fifth showed a grasp of all four basic numerical operations — addition, subtraction, multiplication, and division. Further, once they are at a disadvantage, low-achieving students rarely catch up to the curriculum, but instead appear to fall farther and farther behind.

Based on the typical curriculum, one might expect most 13-year-olds to have had instruction in the skills and understandings needed to perform basic numerical operations and beginning problem solving. Yet only

[3]Iris Weiss, *Report of the 1985-86 National Survey of Science and Mathematics Education* (Research Triangle Park, NC: Research Triangle Institute, 1987).

about three quarters displayed a grasp of the four basic operations and the ability to apply those skills to solve one-step word problems. Many fail to master basic operations and develop initial reasoning and problem-solving skills. NELS 1988 found that about 40 percent of the eighth graders showed proficiency at or above the intermediate level, reflecting some knowledge of decimals, fractions, and percents — reportedly major topics in junior highs and middle schools.[10] NAEP found that only 16 percent of the 13-year-olds — primarily in grades 7 and 8 — had a *consistent* grasp of these concepts.

Performance by high-school students was even more unsettling. Although students graduating from high school seem to be able to add, subtract, multiply, and divide, this level of achievement is hardly in the spirit of our country's goal, which is grounded in competency with challenging subject matter. Only half the 17-year-olds assessed in 1986 demonstrated a grasp of even moderately challenging mathematical procedures and reasoning (i.e., decimals, fractions, and percents; simple equations), and only 6 percent reached the highest level of proficiency defined—a level characterized by a high rate of success on questions measuring multi-step problem solving and algebra.

In summary, despite concentration on the fundamentals of mathematics in elementary schools, only 21 percent of the 9-year-olds and 73 percent of the 13-year olds displayed a firm grasp of the four basic operations and of beginning problem-solving. Without a foundation in problem-solving skills and basic numerical understanding, it may not be surprising that only half the high-school students displayed success with moderately challenging material.

Science

As shown in Table 1.4, students' knowledge of science and their ability to use what they do know appear remarkably limited. Because science is not taught extensively in elementary schools, it may be encouraging that 71 percent of the 9-year-olds demonstrated an understanding of simple

[10] Anne Hafner, Steven Ingels, Barbara Schneider, and David Stevenson, *A Profile of the American Eighth Grader: NELS 88 Student Descriptive Summary* (Washington, DC: National Center for Education Statistics, 1990).

TABLE 1.4

Percentages of Students Performing at or above Science Proficiency Levels, 1986: Ages 9, 13, and 17

Level	Description	Age 9	Age 13	Age 17
350	Can infer relationships and draw conclusions using detailed scientific knowledge	0.4 (0.1)	0.2 (0.1)	7.5 (0.6)
300	Has some detailed scientific knowledge and can evaluate the appropriateness of scientific procedures	3.4 (0.4)	9.4 (0.7)	41.4 (1.4)
250	Understands basic information from the life and physical sciences	27.6 (1.0)	53.4 (1.4)	80.8 (1.2)
200	Understands some basic principles, for example, simple knowledge about plants and animals	71.4 (1.0)	91.8 (0.9)	96.7 (0.4)
150	Knows everyday science facts	96.3 (0.3)	99.8 (0.1)	99.9 (0.1)

Standard errors are presented in parentheses. Those designated as 0.0 are less than .05. It can be said with 95 percent confidence that the percent is within ± 2 standard errors of the estimated value.

scientific principles that went beyond the types of information learned from everyday experiences. The results for 13- and 17-year-olds are quite disappointing, however. Thirteen-year-olds presumably have had instruction in general science and should have developed a basic understanding of the life and physical sciences, as should have virtually all high-school students. However, only about half the 13-year-olds and 81 percent of the 17-year-olds demonstrated even a basic understanding of scientific information and how it might be applied.

The results for the two highest proficiency levels defined by NAEP show that relatively few 13- and 17-year-olds demonstrated some understanding of the design of experiments or any degree of detailed knowledge across the subdisciplines of science. That a very small proportion of middle-school students (9 percent) and only about 41 percent of high-school students can be considered even moderately versed in this subject area is cause for

great concern, as is the very small percentage (8 percent) of high-school students with any degree of specialized knowledge in science.

The NAEP results indicate that there is much to accomplish before our national student achievement goal is met and before the country can consider itself to be at the forefront of science education. All citizens need considerable scientific literacy to understand the changes in the environment and the technologies that surround them in their homes and workplaces, as well as the societal implications of energy use, pollution, space research, genetic engineering and other issues that link society, science, and technology. Further, our country cannot afford to overlook large segments of its population in developing the specialized personnel needed for technologically oriented industries.

U.S. History and Civics

U.S. History. The proficiency results from NAEP's 1988 U.S. history assessment of fourth, eighth, and twelfth graders are presented in Table 1.5. About three-quarters of the fourth graders demonstrated a knowledge of simple historical facts, including national holidays, patriotic symbols, and the fact that George Washington was our first president. They were also able to read simple time-lines, charts, and maps. At grade 8, about two-thirds of the students could identify a range of important historical figures and their accomplishments, including Christopher Columbus, Benjamin Franklin, Abraham Lincoln, and Martin Luther King, Jr. They were familiar with plantations, the California Gold Rush, and the space shuttle. On the other hand, fewer than half of the high-school seniors reached a level of achievement that reflected a general sense of historical chronology and familiarity with the contents of some primary texts in U.S. history, such as the Declaration of Independence, the Constitution, and Bill of Rights. Only 5 percent of these students nearing high school graduation performed at the highest proficiency level, which is characterized by the consistent ability to interpret complex historical information and ideas.

TABLE 1.5

Percentages of Students Performing at or above U. S. History Proficiency Levels, 1988: Grades 4, 8, and 12

Level	Description	Grade 4	Grade 8	Grade 12
350	Knows and can interpret relatively detailed historical information and ideas	0.0 (0.0)	0.1 (0.0)	4.6 (0.5)
300	Understands basic historical terms and relationships	0.2 (0.1)	12.7 (0.5)	45.9 (1.3)
250	Knows beginning historical information and has rudimentary interpretive skills	15.9 (0.9)	67.7 (0.9)	88.9 (0.6)
200	Knows simple historical facts including national holidays and patriotic symbols	76.0 (1.0)	96.0 (0.3)	99.4 (0.1)

Standard errors are presented in parentheses. Those designated as 0.0 are less than .05. It can be said with 95 percent confidence that the percent is within ±2 standard errors of the estimated value.

In general, students' performance can be described as indicating a moderate understanding of some historical events, but far from displaying a coherent grasp of how these events interacted to shape our nation. Evidence of this lack of understanding permeated the assessment results. For example, 56 percent of the fourth graders knew the names of Columbus's ships, but only 36 percent knew why he sailed to America. Although 84 percent of the eighth graders knew how Abraham Lincoln died, only one-quarter knew that his goal in the Civil War was to preserve the Union.

The majority of high-school seniors were familiar with a number of presidents, including Franklin D. Roosevelt (77 percent) and Woodrow Wilson (63 percent). However, when asked to provide a written response contrasting the powers of the president today with those of George Washington, only 40 percent of the twelfth graders could muster at least two reasons why they felt that either one president or the other had more power, and just 10 percent elaborated on the reasons they gave. Given 15 minutes to provide their answers, more than half the high-school seniors wrote responses similar to, or even more vague than, the following:

> *The only difference now in the presidency is there is more power. Earlier presidents had a simpler job than the presidents do now. As you can see, the president has more power now than in our earlier days.*

Civics: U.S. Government and Politics. As shown in Table 1.6, the results of NAEP's 1988 civics assessment parallel the findings in the U.S. history assessment. Approximately 71 percent of our country's fourth graders recognized the existence of civic life and were aware of some of the distinctions between the public and private domains. For example, they understood that governments generally take care of parks and clean streets, demonstrated some knowledge of elections, and knew that individuals accused of crimes have rights.

Sixty-one percent of the eighth graders appeared to have a developing knowledge of the nature of American democratic institutions and processes. For example, these students could differentiate between levels of government and also demonstrated familiarity with a number of our constitutional rights, including the right to vote. Less than half of the high-school seniors appeared to have an overall understanding of specific government structures and their functions. Only 6 percent evidenced broad detailed knowledge of the various institutions of the U.S. government.

TABLE 1.6

Percentages of Students Performing at or above Civics Proficiency Levels, 1988: Grades 4, 8, and 12

Level	Description	Grade 4	Grade 8	Grade 12
350	Understands a variety of political institutions and processes	0.0 (0.0)	0.3 (0.1)	6.0 (0.5)
300	Understands specific government structures and functions	0.1 (0.1)	12.7 (0.7)	49.0 (1.1)
250	Understands the nature of political institutions and the relationship between citizen and government	9.6 (0.8)	61.4 (1.0)	89.2 (0.7)
200	Recognizes the existence of civic life	71.2 (1.2)	94.4 (0.4)	98.8 (0.2)

Standard errors are presented in parentheses. Those designated as 0.0 are less than .05. It can be said with 95 percent confidence that the percent is within ± 2 standard errors of the estimated value.

Although performance at the higher levels on the NAEP civics scale was generally typified by increased depth and breadth of knowledge and concepts, students demonstrated a surprisingly uneven understanding within the various areas of the civics assessment. For example, even though by grade 4 most students were familiar with voting, elections, and the ballot, only 36 percent of the eighth graders and 57 percent of the twelfth graders appeared to know that presidential candidates are nominated by national conventions — and this assessment took place at the peak of the 1988 national primaries.

When probed about their understanding of the Constitution and the structure and operation of the three branches of American government, three-quarters of the eighth graders recognized that courts can decide sex discrimination cases. However, only 41 percent knew that the U.S. Supreme Court can declare laws unconstitutional. Also, at grade 8, 60 percent

knew that senators were part of the legislative branch of government and almost as many (56 percent) identified the two houses of Congress. Yet, only 38 percent seemed to know that Congress makes laws. Eighty-five percent of the high-school seniors knew that Congress cannot curtail freedom of the press, but only 39 percent knew that Congress can double the income tax.

Finally, when asked about specific rights and liberties guaranteed in the U.S. Constitution, virtually all of the high-school seniors (98 percent) knew that the accused have a right to a lawyer, but only 51 percent knew that religious freedom is guaranteed in the Constitution.

In summary, students' grasp of U.S. history and civics seems quite disjointed, even among our soon-to-be eligible voters. This suggests that they may be inadequately prepared for the responsibilities of informed citizenship. Students do not appear to have a competent grasp of the events that form the foundation of our country's civic tradition and political development or even, necessarily, a very thorough grasp of the Constitution and how our government is structured.

Geography

NAEP's 1988 geography assessment was conducted only at the twelfth grade. Yet, the geography learning of high-school seniors paints a disappointing picture. It is worth noting that only 64 percent of these seniors reported any type of geography coursework in grades 9 to 12.

Students were most successful when asked to locate major countries. For example, 85 percent recognized the Soviet Union on a world map. However, twelfth graders had much more difficulty locating cities and physical land features. For example, only 58 percent were able to identify Jerusalem on a regional map and only 50 percent knew the Panama Canal would cut sailing time between New York and San Francisco rather than, for example, from New York to London. When given a dot map of population distribution showing Europe, India, China, and Japan virtually shaded in, almost one-quarter of the students indicated that the map represented abundant mineral deposits. Only half recognized that the map actually represented population concentrations.

Although high-school seniors appear to have basic map-reading abilities, such as the ability to interpret symbols and identify direction, less than two-thirds of the students demonstrated familiarity with the concepts of latitude and longitude. They also had difficulty when asked to make inferences or interpretations based on the information presented in a single map and particular difficulty synthesizing information across maps. For example, when presented with two maps of the same area — one showing amount of rainfall and the other showing elevation — only 27 percent of the students put the two sets of information together to identify areas of likely soil erosion.

Twelfth graders' understanding of cultural geography seemed to be limited to events and issues addressed in the media. For example, 79 percent appeared to understand the primary way to control acid rain and 69 percent identified a risk to the environment resulting from the use of pesticides. However, few seemed to understand these issues in depth. For example, only 59 percent recognized the consequences of cutting down the rain forests and only 53 percent identified a cause of the greenhouse effect.

High-school seniors also had limited success with the physical geography questions about climate, weather, tectonics, and erosion. Only about two-thirds knew the cause of the Earth's seasons. Also, on a very basic question in the area of tectonics, these twelfth graders were shown a simple cross-sectional drawing depicting a sharp fracture in the Earth's crust. Only 60 percent recognized evidence of faulting in this diagram.

In summary, high-school seniors demonstrated generally low performance across all four areas emphasized in the geography assessment — location and place, skills and tools, cultural geography, and physical geography.

Students Learning to Use their Minds Well

Throughout the preceding discussions of students' achievement levels in English, mathematics, science, U.S. history, civics, and geography, we have presented numerous results that suggest that many students are not using their minds well. In reading, they have difficulty identifying the global messages and purposes of text and even greater difficulty articulating evidence to support their understandings. When asked to write, they provide sparse, unelaborated, and unsupported text. They have great difficulty when asked to analyze information in writing or to provide arguments or refutations.

In mathematics, most students graduate with a basic grasp of the four basic numerical operations, but only about half demonstrate facility with more complex skills such as the ability to compute with decimals, fractions, and percents. Only a few appear to comprehend algebra or to be able to solve multi-step problems. The science results are equally disappointing. Less than half the high-school students were able to evaluate the appropriateness of scientific procedures and far fewer (8 percent) were able to infer relationships and draw conclusions using detailed scientific knowledge.

Students' ability to use or apply information about various aspects of our country and world also seems quite limited. They do learn a great number and variety of facts as they progress through school, but their understanding of our country's geography, history, Constitution, and political structure is disjointed and uneven, and their ability to make connections or to relate sets of information appears highly restricted.

In U.S. history, fewer than half the high-school seniors demonstrated a grasp of basic historical relationships and only 5 percent were able to interpret relatively detailed historical information and ideas. Although about half seemed to understand specific government structures and functions, very few (6 percent) evidenced an understanding that encompassed the entire network of a variety of political institutions and processes prevalent in our country.

In geography, twelfth graders were able to locate major countries and to use basic map reading skills. However, when asked to apply their geographic knowledge, identify implications of environmental

conditions, or interpret and relate information from multiple sources, few were successful.

Summary

When the NAEP results are taken as a whole and related to our country's overarching goal for student achievement and citizenship, the result is a bleak portrait of the current status of student achievement in the United States. Large proportions, perhaps more than half, of our elementary, middle-school, and high-school students are unable to demonstrate competency in challenging subject matter in English, mathematics, science, history, and geography. Further, even fewer appear to be able to use their minds well. Across the NAEP findings, cumulative evidence shows that, for any curriculum area, only about half of our high-school seniors may be graduating with the ability "to use their minds" to think through subject-related information in any depth. Fewer than 10 percent appear to have both an understanding of the specialized material and ideas comprising that curriculum area and the ability to work with these to interpret, integrate, infer, draw generalizations, and articulate conclusions.

Because the definitions of "competence" and "challenging subject matter" are open to debate, it is difficult to estimate exactly how much our nation needs to improve to reach our education achievement goal. We are far from attaining it, however, regardless of any reasonable definition. The current levels of student achievement are unacceptably low for our country's needs and aspirations and for the personal goals of its citizens.

2 What Progress Has Been Made in Higher-Order Thinking Skills?

Objectives: *The academic performance of elementary and secondary students will increase significantly in every quartile...The percentage of students who demonstrate the ability to reason, solve problems, apply knowledge, and write and communicate effectively will increase substantially.*

The economic position of the United States compared to that of other nations is much different today than it was in 1970. Our competitive advantage has eroded as our technological capabilities have been matched or even surpassed in some areas by other countries. As our political and business leaders turn to the educational system to provide the workers and citizens needed to reestablish our economic strength in the global community, they emphasize the need not only for overall improvement in students' academic achievement, but also for improvement in reasoning and problem-solving skills.[1]

Both of these needs are referenced in the national objectives that accompany the overarching goal of improved academic achievement, calling for significant improvement at each performance level across the distribution and for substantial increases in the percentage of students who reach the higher levels on the scale. Thus, it is informative to examine the NAEP trend results across the past decades from these two perspectives: Have levels of academic achievement been improving? Do more students now have the ability to reason and communicate effectively?

This chapter begins with a discussion of trends in overall performance in reading, mathematics, science, civics, and writing, followed by a discussion on achievement trends across the various scale levels in reading, science, and mathematics. By examining how changes across time have been distributed across the types of skills and knowledge represented in NAEP assessments, we can comment on current progress toward raising performance at all levels, in general, and at the levels representing more complex skills, in particular.

[1] National Center on Education and the Economy, *America's Choice: High Skills or Low Wages* (Rochester, NY: June 1990).

Overall Trends

This section briefly summarizes the trend results for reading, mathematics, science, and civics, presented in Figure 2.1.[12] Writing trend results are also discussed. In general, the achievement trends are not heartening. There have been various declines and improvements from assessment to assessment, but over the long term, achievement levels are quite stable.

Reading. Across all three ages assessed, overall reading performance in 1988 was as good as, if not slightly better than, it was nearly two decades earlier. Nine-year-olds participating in the most recent assessment were reading significantly better than their counterparts in 1971, although their average proficiency did not improve in the 1980s and may actually have declined somewhat during that period. The reading proficiency of 13-year-olds has shown little change, while 17-year-olds also were reading better in 1988 than in 1971, reflecting gains made during the 1980s.

Mathematics. In 1986, mathematics performance had changed very little from the levels achieved in 1973. However, at all three ages, and at age 17 in particular, the results suggest a pattern of dips in performance followed by recovery. Therefore, recent performance may be gradually improving, albeit somewhat unevenly. The question remains, however, whether the recent upturn in performance represents the beginning of a positive trend back to and even beyond previous levels or only an abatement of previous declines.

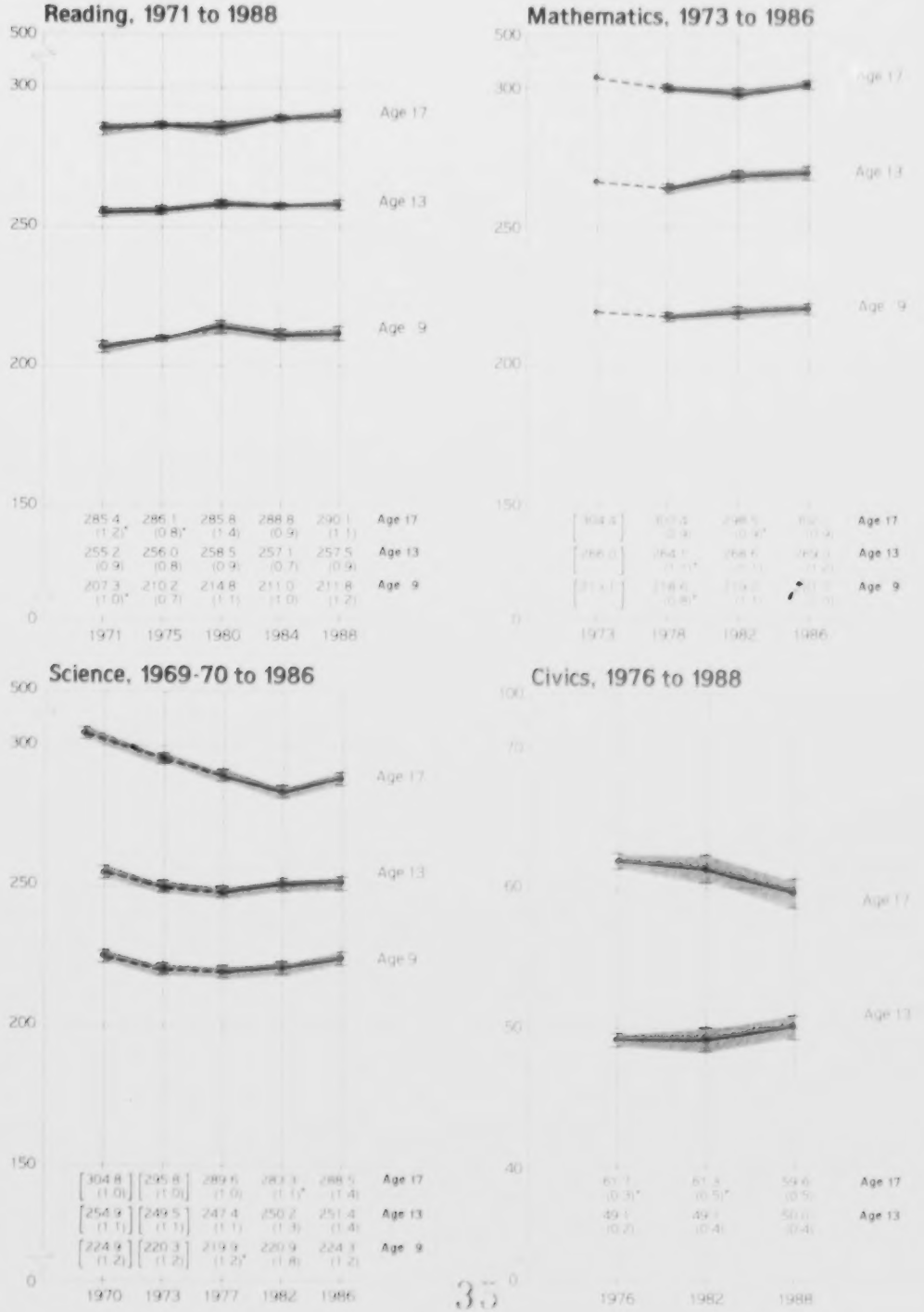
Science. Viewed as a whole, science achievement in 1986 remained below the levels attained in 1969.[13] Trends at ages 9 and 13 are characterized by a decline in the early 1970s, stable performance at that lower level of achievement through the 1970s, and improvement in the 1980s. With these gains, average proficiency at age 9 returned to that of the first science assessment in 1970, but average proficiency at age 13 still remained slightly below the 1970 level. At age 17, science performance dropped steadily from 1969 to 1982, but improved significantly from 1982 to 1986. Although the recent gains are encouraging, performance in 1986 remained well below that of 17-year-olds in 1969.

[12] Unlike the other subject area scales presented, which range from 0 to 500, the civics trend scale ranges from 0 to 100. As noted earlier, the scales for the different subject areas are not comparable.

[13] In the first science assessment, 17-year-olds were assessed in the 1968-69 school year, and 9- and 13-year-olds were assessed in the 1969-70 school year.

FIGURE
2.1

National Trends in Average Proficiency in Various Subject Areas: Ages 9, 13, and 17



Standard errors are presented in parentheses. It can be said with 95 percent confidence that the average proficiency of the population of interest is within ± 2 standard errors of the estimated value.

[- - -] Extrapolations based on previous NAEP analyses.

*Statistically significant difference from the most recent assessment at the .05 level.

95% confidence interval

Civics. In general, students' achievement in civics was not as high in 1988 as it was in 1976. Although 13-year-olds tended to perform as well as, if not better than, their predecessors, 17-year-olds performed significantly worse than their counterparts in either 1976 or 1982.

Writing. Writing achievement appears to have been relatively stable across the 1970s and 1980s. Trend assessments conducted in 1974, 1979, and 1984 indicated mixed results at age 9, and the trend assessments from 1984 to 1988 indicated little overall change in the writing of elementary-school students, although they improved on some tasks and did not decline on any. For middle-school students, the net effect is also one of relative stability. Mixed trends between 1974 and 1979 were followed by improved performance in 1984. However, between 1984 and 1988, eighth graders showed more declines than gains. Despite evidence of a dip in performance in 1979, performance for high-school students also has been quite stable.

In summarizing achievement trends in various subject areas over the past 20 years or so, we see little evidence to suggest that achievement levels are much higher as we proceed into the 1990s than they were when we entered the decade of the 1970s. The general pattern of declines in the 1970s, followed by improvements to original levels of performance during the 1980s, however, may suggest a silver lining to the dark cloud. At least the trends are generally upward and these forecast continued positive effects as we approach the 21st century. Still, the pace must be accelerated if we are to realize the regular, dramatic gains needed to achieve our goal.

Trends in Levels of Proficiency

The NAEP results indicate a remarkable consistency across subject areas — students are learning facts and skills, but few show the capacity for complex reasoning and problem solving. Recent assessments indicate that performance is improving, which is laudable, but overall achievement levels remain similar to those posted two decades ago. As shown in Figure 2.2, which presents information on achievement trends across the levels of the NAEP scales in different subject areas, most of the gains appear to have occurred in lower-level skills and basic concepts — material generally thought to be learned in elementary or perhaps middle school. In contrast, most of the declines have occurred in the area of higher-level applications.

FIGURE
2.2

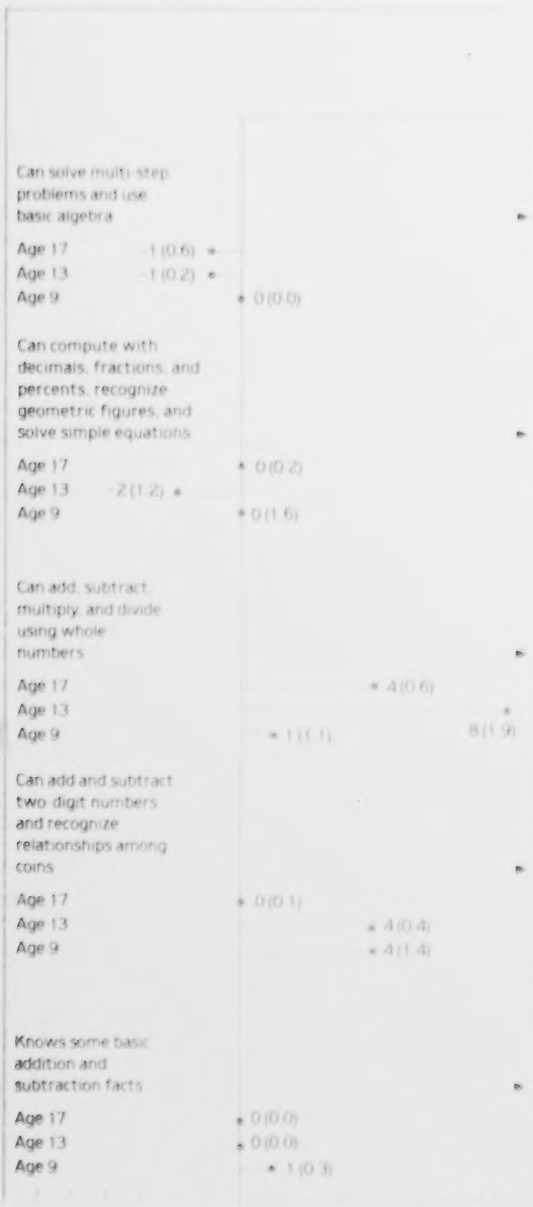
Reading: 1971 to 1988

Changes Across Time in the Percentage of Students at or Above Anchor Points in Various Subject Areas

LEVEL
350 ►
Can synthesize and learn from specialized reading materials
Age 17 -2 (0.6) *
Age 13 * 0 (0.1)
Age 9 * 0 (0.0)
300 ►
Can find, understand, summarize and explain relatively complicated information
Age 17 * 3 (1.6)
Age 13 * 1 (0.9)
Age 9 * 0 (0.2)
250 ►
Can search for specific information, interrelate ideas, and make generalizations
Age 17 *
Age 13 * 0 (1.6) 8 (1.1)
Age 9 * 2 (1.0)
200 ►
Can comprehend specific or sequentially related information
Age 17 * 3 (0.4)
Age 13 * 2 (0.6)
Age 9 * 4 (1.5)
150 ►
Can carry out simple, discrete reading tasks
Age 17 * 0 (0.0)
Age 13 * 0 (0.1)
Age 9 * 3 (0.8)
6 5 4 3 2 1 0 1 2 3 4 5 6 7 8
LOSS
GAIN

Standard errors are presented in parentheses. It can be said with 95 percent confidence that the difference in percents is within ± 2 standard errors of the estimated value.

Mathematics: 1973 to 1986


Can solve multi-step problems and use basic algebra
Age 17 -1 (0.6) *
Age 13 -1 (0.2) *
Age 9 * 0 (0.0)
Can compute with decimals, fractions, and percents, recognize geometric figures, and solve simple equations
Age 17 * 0 (0.2)
Age 13 -2 (1.2) *
Age 9 * 0 (1.6)
Can add, subtract, multiply, and divide using whole numbers
Age 17 * 4 (0.6)
Age 13 *
Age 9 * 1 (1.1) 8 (1.9)
Can add and subtract two-digit numbers and recognize relationships among coins
Age 17 * 0 (0.1)
Age 13 * 4 (0.4)
Age 9 * 4 (1.4)
Knows some basic addition and subtraction facts
Age 17 * 0 (0.0)
Age 13 * 0 (0.0)
Age 9 * 1 (0.3)
6 5 4 3 2 1 0 1 2 3 4 5 6 7 8
LOSS
GAIN

Science: 1969-70 to 1986

Can infer relationships and draw conclusions using detailed scientific knowledge
Age 17 -1 (0.6) *
Age 13 -1 (0.2) *
Age 9 * 0 (0.0)
Has some detailed scientific knowledge
Age 17 * 0 (0.2)
Age 13 -2 (1.2) *
Age 9 * 0 (1.6)
Understands basic information from the life and physical sciences
Age 17 -1 (1.4) *
Age 13 * 4 (1.8)
Age 9 * 1 (1.2)
Understands some basic principles; for example, simple knowledge about plants and animals
Age 17 -1 (0.4) *
Age 13 * 6 (1.1)
Age 9 * 3 (1.5)
Knows everyday science facts
Age 17 * 0 (0.1)
Age 13 * 1 (0.1)
Age 9 * 3 (0.6)
6 5 4 3 2 1 0 1 2 3 4 5 6 7 8
LOSS
GAIN

On one hand, schools can be congratulated for increasing the percentages of students learning basic facts and procedures. However, while we have raised performance at the lower levels of the distribution, we have lost ground at the higher levels.The latter trend is in direct conflict with the needs of today's society, which is growing increasingly complex. Our changing world has led to new expectations for academic learning that go beyond reciting facts and displaying routines to encompass reasoning, solving problems, applying knowledge, and communicating effectively. Yet, as the data in this report show, it is in this domain that students have regressed most.

Summary

The general lack of significant gains in student achievement across the past two decades suggests that we have to make substantial progress in this last decade before the 21st century. First, average proficiency levels in various subject areas have remained essentially constant during the past 20 years. Although some gains occurred in students' reading performance, these are offset by losses in science achievement. In mathematics and writing, performance has stayed virtually the same across time.

Second, although the changes in average performance have been relatively modest, they reflect a balancing of gains and losses in different content and skill areas and for different groups of students. Whereas progress has been made in the area of basic skills, declines have occurred in the proportions of students who demonstrate the ability to reason effectively. To fulfill the objective stated at the beginning of this chapter — increasing the percentages of students who are able to perform higher-level applications — we will first have to stem the downward trends in these percentages noted across the past two decades.

Our country *can* strengthen the academic achievement of its students. This is evident in the improvements made at the lower end of the scales. If a need is identified and an extensive effort mounted, as illustrated by the "back to the basics" movement of the 1970s, then positive effects can be achieved. A similar level of effort, with similar results, is needed if commensurate increases are to be achieved at the higher end of the performance distribution.

3 What Is the Status of Equity in Educational Achievement?

Objective: *. . . the distribution of minority students in each level will more closely reflect the student population as a whole.*

Among the many goals of the educational reform movement over the past 20 to 30 years, two important aims have been to strengthen the academic performance of minority students and to close the gender achievement gaps favoring males in mathematics and science and favoring females in reading and writing. As we measure our progress toward these goals, the NAEP results are a valuable resource, offering information on both the current and past status of achievement differences. In a number of subject areas — including reading, mathematics, and science — NAEP has been tracing achievement trends for nearly two decades for subgroups of students defined by race/ethnicity, gender, and other characteristics.

In viewing the average performance results presented in this chapter, it should be remembered that averages mask variations in performance among students in any given grade or subpopulation. For example, while White students had higher reading proficiency than Black students on average, there are some White students among the least proficient in reading and some Black students among the most proficient. Similarly, while the average writing proficiency of females was higher than that of males, some males were among the strongest writers and some females were among the weakest. Thus, the averages do not reveal the full range of performance for any given population.

Performance Comparisons by Race/Ethnicity

Across the grades and subject areas assessed by NAEP, Black and Hispanic students have tended to perform comparably. However, both of these minority groups demonstrated significantly lower proficiency than White students, on average. In virtually every subject assessed — including reading, mathematics, science, U.S. history, and civics — the average performance of Black and Hispanic high-school students (17-year-olds or twelfth graders) has been more comparable to the performance of White middle-school students

(13-year-olds or eighth graders) than to that of White high-school students. The relevant data are shown in Table 3.1.

Although the performance disparities between White students and their Black and Hispanic counterparts remain unacceptably large, some progress appears to have been made in reducing the differences. Figure 3.1 displays trends in the average performance differences between White and Black students in the subject areas assessed by NAEP across the years.

Trend information from the five NAEP *reading* assessments conducted during the 1970s and 1980s reveals that the average performance gap between White and Black students has been reduced at all three age levels — particularly at age 17. These findings reflect, at least in part, the dramatic gains in performance made by Black 17-year-olds, an especially noteworthy achievement given that the dropout rate among Black high-school students has been declining since 1970.[11]

As a result of these gains, in 1988, the average performance gap between White and Black students became smaller as students progressed through school: at age 9, the gap was 29 points, and at age 17, it was 20 points. This is a striking difference from the results of the first reading assessment in 1971, when the gap ranged from 44 points at age 9 to 53 points at age 17.

These signs of progress are encouraging. However, it is important to note that the reduction in the performance gap across time was less evident among the younger students than among the older students. In particular, the results for the 9-year-old students reveal little progress during the 1980s in closing the gap between White and Black students.

Across the four *mathematics* assessments conducted by NAEP in 1973, 1978, 1982 and 1986, the average performance differences between White and Black students have narrowed steadily at all three age levels. In 1986, the gap in average mathematics performance remained fairly constant from age 9 (25 points) to age 17 (29 points).

[11] *Youth Indicators* (Washington, D.C.: U.S. Department of Education, 1988), p. 34.

TABLE 3.1

Average Proficiency in Various Subject Areas by Race/Ethnicity

	Age 9	Age 13	Age 17
Reading: 1988			
Nation	211.8 (1.2)	257.5 (0.9)	290.1 (1.1)
White	217.7 (1.5)	261.3 (1.0)	294.7 (1.3)
Black	188.5 (2.6)	242.9 (2.3)	274.4 (2.6)
Hispanic	193.7 (3.9)	240.1 (3.5)	270.8 (4.0)
Mathematics: 1986			
Nation	221.7 (1.0)	269.0 (1.2)	302.0 (0.9)
White	226.9 (1.1)	273.6 (1.3)	307.5 (1.0)
Black	201.6 (1.6)	249.2 (2.3)	278.6 (2.1)
Hispanic	205.4 (2.1)	254.3 (2.9)	283.1 (2.9)
Science: 1986			
Nation	224.3 (1.2)	251.4 (1.4)	288.5 (1.4)
White	231.9 (1.2)	259.2 (1.4)	297.5 (1.7)
Black	196.2 (1.9)	221.6 (2.5)	252.8 (2.9)
Hispanic	199.4 (3.1)	226.1 (3.1)	259.3 (3.8)
	Grade 4	**Grade 8**	**Grade 12**
U.S. History: 1988			
Nation	220.6 (0.9)	263.9 (0.7)	295.0 (1.0)
White	227.5 (1.0)	270.4 (0.8)	301.1 (1.2)
Black	199.5 (1.9)	246.0 (1.5)	274.4 (1.7)
Hispanic	202.7 (1.7)	244.3 (1.9)	273.9 (1.8)
Civics: 1988			
Nation	214.0 (0.9)	259.7 (0.9)	296.3 (1.1)
White	220.0 (1.0)	266.3 (1.2)	301.9 (1.2)
Black	198.1 (2.2)	243.6 (1.9)	273.8 (1.9)
Hispanic	199.5 (1.9)	240.6 (1.7)	279.2 (2.3)
Geography: 1988			
Nation	—	—	293.1 (1.0)
White	—	—	301.1 (1.1)
Black	—	—	258.4 (2.0)
Hispanic	—	—	271.8 (3.9)

Standard errors are presented in parentheses. It can be said with 95 percent confidence that the average proficiency of the population of interest is within ± 2 standard errors of the estimated value.

Progress in reducing the performance disparities between White and Black students was also evident in the *science* achievement results, although the changes there have been somewhat more erratic from assessment to assessment than in the other subject areas. Although progress from 1970 to 1986 has been substantial at ages 9 and 13, the results at age 17 are less encouraging. The most recent period (from 1982 to 1986) appears to have been one of success in reducing the science achievement gap between White and Black 17-year-olds. Yet, in 1986, the gap between these two groups was larger at age 17 (45 points) than at age 9 (36 points).

Figure 3.2 shows similar trend information on the performance differences between White and Hispanic students. In reading, steady progress has been made at all three ages in reducing the performance disparities between White and Hispanic students. In 1988, as in some of the previous assessment years, the performance gap in reading remained fairly constant from age 9 to age 17.

In *mathematics*, progress has been made at ages 13 and 17, but not at age 9. Whereas the gap increased from age 9 to ages 13 and 17 in the earlier assessments, it remained fairly constant across the three age groups in 1986. It is encouraging that Hispanic students no longer appear to be losing ground relative to their White classmates as they move through school; however, the persistent gap in mathematics proficiency at age 9 remains perplexing.

The differences found in the *science* assessment results are very erratic. While the disparities were apparently reduced somewhat between 1977 and 1986 at ages 9 and 13, the gap in average performance between White and Hispanic students may have actually widened slightly at age 17 across the assessment years.

FIGURE
3.1

Difference in Average Proficiency of White and Black Students Across Subject Areas, 1971 to 1988

Standard errors are presented in parentheses. It can be said with 95 percent confidence that the difference in average proficiency scores is within ± 2 standard errors of the estimated value.

MATHEMATICS

Difference in Average Proficiency Scores on the NAEP Scale: White Minus Black

SCIENCE

Difference in Average Proficiency Scores on the NAEP Scale: White Minus Black

FIGURE
3.2

Difference in Average Proficiency of White and Hispanic Students Across Subject Areas, 1973 to 1988

Standard errors are presented in parentheses. It can be said with 95 percent confidence that the difference in average proficiency scores is within ± 2 standard errors of the estimated value.

MATHEMATICS

Difference in Average Proficiency Scores on the NAEP Scale: White Minus Hispanic

SCIENCE

Difference in Average Proficiency Scores on the NAEP Scale: White Minus Hispanic

In addition to the subjects discussed previously, the NAEP results make it possible to examine differences in the *writing* achievement of White, Black, and Hispanic students and to examine how these differences have changed in recent years. Table 3.2 provides information on the average writing performance of White, Black, and Hispanic students and on the performance disparities between these groups.

TABLE 3.2

Average Proficiency in Writing by Race/Ethnicity, 1984 to 1988

	Grade 4		Grade 8		Grade 11	
	1984	1988	1984	1988	1984	1988
Nation	170.5 (1.7)	173.3 (1.3)	212.4 (1.4)	208.2 (0.8)	223.0 (2.1)	220.7 (1.2)
White	177.2 (1.9)	180.0 (1.6)	217.9 (1.5)	213.1 (1.0)	229.1 (2.1)	225.3 (1.3)
Black	148.2 (4.0)	150.7 (3.1)	188.3 (4.1)	190.1 (2.3)	204.2 (4.1)	206.9 (2.6)
Difference	**29.0 (4.4)**	**29.3 (3.5)**	**29.6 (4.4)**	**23.0 (2.5)**	**24.9 (4.6)**	**18.4 (2.9)**
Hispanic	157.9 (4.5)	162.2 (3.6)	194.2 (6.9)	197.2 (3.2)	200.6 (4.6)	202.0 (3.2)
Difference	**19.3 (4.9)**	**17.8 (3.9)**	**23.7 (7.1)**	**15.9 (3.4)**	**28.5 (5.1)**	**23.3 (3.5)**

Note: The rows of numbers in bold type display differences in average writing achievement between White students and their Black and Hispanic counterparts. The writing results were estimated on a 0 to 400 scale using the Average Response Method (ARM). Standard errors are presented in parentheses. It can be said with 95 percent confidence that the average proficiencies and the differences are within ± 2 standard errors of the estimated values.

Similar to the results from the NAEP assessments in other subject areas, the writing achievement of White students was substantially higher, on average, than that of Black or Hispanic students. The latter two groups performed comparably.

The gaps in average writing performance between White students and their Black and Hispanic counterparts showed little change across time at any of the three grade levels, although similar fluctuations were noted among the racial/ethnic groups for older students. At the fourth grade, the gaps found in 1988 were approximately the same as they were in 1984. At grades 8 and 11, some modest narrowing of the gaps occurred, although the differences found in 1988 were roughly of the same magnitude as they had been four years earlier.

In summary, across virtually all subject areas assessed by NAEP, the achievement of minority students has improved across time relative to that of White students. This indicates an ability to continue making progress toward our nation's goal of increasing the achievement levels of minority students. The greatest gains have been made in closing the gap in reading performance between White and minority students, although progress at age 9 appears to have stalled during the 1980s. Steady gains have been made in mathematics at all three ages. The most erratic trends are for science, although progress has been made in that subject, as well. In considering these encouraging findings, though, two points must be kept in mind. The first is that the gaps in average performance between White students and their Black and Hispanic classmates remain unacceptably large. The second is that the progress made in reducing the disparities between these groups has primarily been a result of improved performance by minority students. The levels of performance shown by White students have remained quite stagnant across time.

Performance Comparisons by Gender

As shown in Table 3.3, the average performance results for males and females reinforce the evidence that females have an advantage in reading and that males have an advantage in mathematics and science. The results also reveal performance disparities favoring males in U.S. history, civics, and geography.

TABLE
3.3

Average Proficiency in Various Subject Areas by Gender

	Age 9	Age 13	Age 17
Reading: 1988			
Nation	211.8 (1.2)	257.5 (0.9)	290.1 (1.1)
Male	207.5 (1.5)	251.8 (1.2)	286.0 (1.5)
Female	216.3 (1.4)	263.0 (1.0)	293.8 (1.6)
Mathematics: 1986			
Nation	221.7 (1.0)	269.0 (1.2)	302.0 (0.9)
Male	221.7 (1.1)	270.0 (1.1)	304.7 (1.2)
Female	221.7 (1.2)	268.0 (1.5)	299.4 (1.0)
Science: 1986			
Nation	224.3 (1.2)	251.4 (1.4)	288.5 (1.4)
Male	227.3 (1.4)	256.1 (1.6)	294.9 (1.9)
Female	221.3 (1.4)	246.9 (1.5)	282.3 (1.5)
	Grade 4	**Grade 8**	**Grade 12**
U.S. History: 1988			
Nation	220.6 (0.9)	263.9 (0.7)	295.0 (1.0)
Male	222.9 (1.2)	266.2 (1.0)	298.5 (1.3)
Female	218.2 (1.0)	261.6 (0.8)	291.8 (1.1)
Civics: 1988			
Nation	214.0 (0.9)	259.7 (0.9)	296.3 (1.1)
Male	214.8 (1.3)	258.7 (1.1)	298.6 (1.6)
Female	213.3 (1.1)	260.6 (0.9)	294.1 (1.1)
Geography: 1988			
Nation	—	—	293.1 (1.0)
Male	—	—	301.2 (1.6)
Female	—	—	285.7 (1.2)

Standard errors are presented in parentheses. It can be said with 95 percent confidence that the average proficiency of the population of interest is within ± 2 standard errors of the estimated value.

The gender performance gap favoring females in reading (approximately 8 to 11 points) remains relatively constant as students progress through school. The mathematics and science results reveal quite a different pattern, however. In mathematics, there is essentially no gender performance gap among 9-year-olds, but by age 17, the average proficiency of males is 5 points higher than that of females. In science, a 6-point difference that is present at age 9 widens to a 13-point difference at age 17.

The performance advantage held by males in mathematics and science is found in other subjects, as well. The U.S. history assessment results show a modest advantage for males that remains constant as students progress through school. And while males and females performed comparably in the civics assessments at ages 9 and 13, a small gap was evident by age 17. The largest gap found in any of the assessment results was in geography, where the average performance of twelfth-grade males was 15 points higher than that of their female peers.

These disparities are perplexing in and of themselves, but they are even more so when one finds that the differences are not a result of differential course-taking. Course-taking per se appears to have little effect on reducing the performance gap between males and females. For example, the 1986 mathematics and science assessments showed that even when males and females had taken the same courses in these subject areas, the differences in average proficiency between the two groups persisted.

In addition to studying the magnitude of existing performance disparities between males and females, it is useful to know to what extent these gaps have changed across time. Figure 3.3 provides that information. In reading, the gender gap favoring females has been narrowing slowly across time. This is primarily due to gains in males' average reading proficiency, especially at age 17, and to the concurrent lack of change in females' reading achievement. In mathematics and in science, little progress has been made in closing the gender gap favoring males. These gaps are especially perplexing in that they seem to appear and grow more pronounced as students progress through school. Thus, they are widest at the higher age levels.

FIGURE
3.3

Difference in Average Proficiency of Female and Male Students Across Subject Areas, 1971 to 1988

Standard errors are presented in parentheses. It can be said with 95 percent confidence that the difference in average proficiency scores is within ± 2 standard errors of the estimated value.

MATHEMATICS

Difference in Average Proficiency Scores on the NAEP Scale: Male Minus Female

SCIENCE

Difference in Average Proficiency Scores on the NAEP Scale: Male Minus Female

Across the years, the results of the NAEP writing assessments have consistently indicated a strong performance advantage for females. Table 3.4 provides information on the differing trends in average writing achievement for males and females.

3.4

Average Proficiency in Writing by Gender, 1984 to 1988

	Grade 4		Grade 8		Grade 11	
	1984	1988	1984	1988	1984	1988
Nation	170.5 (1.7)	173.3 (1.2)	212.4 (1.4)	208.2 (0.8)	223.0 (2.1)	220.9 (1.3)
Female	176.7 (1.9)	182.4 (1.6)	222.5 (1.5)	218.2 (1.1)	234.5 (2.4)	229.2 (1.3)
Male	165.0 (2.7)	164.3 (1.9)	204.5 (2.4)	197.9 (1.4)	211.9 (2.0)	211.5 (1.5)
Difference	11.7 (3.3)	18.1 (2.5)	16.0 (2.8)	20.3 (1.8)	22.6 (3.8)	18.1 (2.1)

Note: The use of unrelated scales could lead misleading differences in average writing achievement between female and male students. The writing results are estimated on a 0 to 500 scale using the Average Response Method (ARM). Standard errors are presented in parentheses. It can be said with 95 percent confidence that the average proficiencies and the differences are within ± 2 standard errors of the estimated values.

At all three grades assessed, the average writing proficiency of females was substantially higher than that of their male peers. From 1984 to 1988, the performance of fourth-grade girls rose while the performance of boys remained fairly constant. At the eighth- and eleventh-grade levels, the changes were inconsistent. As a result of these patterns, the gender performance gap at grade 4 increased from 12 points in 1984 to 18 points in 1988, while at grades 8 and 11 the gaps remained essentially the same.

Summary

When NAEP's trend assessment results are compared for students belonging to different subpopulations of interest — in particular, racial/ethnic and gender groups — it is apparent that considerable progress has been made in closing the performance gaps that have existed across time. In particular, the performance gains shown by Black and Hispanic students, combined with the relative lack of change in performance by White students, have combined to reduce the performance gap between White and minority students. Despite this progress, however, the gaps remain far too large to meet our nation's objective of close parallels between the performance of minority students and that of the student population as a whole.

The performance disparities between males and females appear to have been more resistant to change. In reading, the gender gap traditionally held by females has been eroding across time, primarily as the result of improvements in males' average reading proficiency. In contrast, there has been relatively little progress in closing the gender gap found in mathematics and science at the higher age levels. Further, a gender gap favoring males was evident in the 1988 assessments of U.S. history, civics, and geography.

The NAEP results offer evidence that our nation has the capacity to raise the achievement levels of minority students. Yet they also highlight the substantial amount of work that remains to be accomplished in this area. If, by the year 2000, the achievement levels of minority students are to more closely reflect the achievement levels of the nation as a whole, then progress must accelerate in this decade toward reducing racial/ethnic and gender performance disparities.

4 What Can Be Done to Improve Student Achievement?

As part of its ongoing assessments of students' academic achievement, NAEP collects information on an extensive array of background variables related to education. Through questionnaires administered to students, teachers, and principals, NAEP is able to provide a broad picture of educational practices prevalent in American schools and classrooms. In many instances, however, these findings contradict our perceptions of what school is like or educational researchers' suggestions about what strategies work best to help students learn.

For example, having the opportunity to learn subject matter has long been considered important to educational achievement. Yet, the NAEP data show that students and teachers often report devoting much less instructional time to core subject areas than may be commonly thought to be the case, and that many high-school students do not take advanced coursework in these subjects. Also, research has indicated new and more successful ways of teaching and learning, incorporating more hands-on activities and student-centered learning techniques; however, NAEP data indicate that most classroom work is still dominated by passive learning activities in which information is delivered to students by teachers and textbooks. Finally, it is widely recognized that home environment has an enormous impact on future academic achievement. Yet, large proportions of students report little home support for reading activities, excessive hours of watching television, and hardly any time spent doing homework.

English: Reading and Writing

The broad-based research into how children learn to read includes many suggestions on how students, parents, teachers, and schools can work separately and together to improve students' reading abilities. In addition, much recent research has been directed toward the connections between reading and writing, and how to teach writing more effectively. Some of these findings and their relationship to NAEP results are summarized in the following sections of this chapter. Unfortunately, it appears from the NAEP data that actual practice may be far removed from research recommendations about what works best.

Improving Reading Achievement by Reading

A long series of previous studies has shown that children who grow up in environments that support reading activities develop better reading skills, as do those students who read a lot both in school and at home.[15] Home support for reading appears to be central in fostering higher academic achievement. Parents can encourage leisure reading, support visits to the library, and help their young children to become better readers by reading to them and discussing the stories.[16] Yet, less than half of the fourth-grade students (44 percent) reported that they were read to on a daily basis when they were preschoolers, and 13 percent said they were never read to at that age. Further, 25 percent of the fourth graders and approximately one-third of the eighth and twelfth graders reported that they had fewer than 10 books of their own at home, and their reading proficiency was substantially lower than that of their classmates who reported having more books in the home.

Consistent with previous research findings, NAEP results show that the more often students reported reading in their leisure time, the higher their reading proficiency was likely to be.[17] However, the frequency with which students read for pleasure seems to decrease as they grow older. Compared to approximately three-quarters of the fourth graders, only about half of the high-school seniors reported reading for fun on at least a weekly basis. Conversely, 16 percent of the fourth graders, 22 percent of the eighth graders, and 29 percent of the high-school seniors reported spending little or no time reading for pleasure. The small amount of time spent reading is in sharp contrast with the amount of time that students dedicate to television: 69 percent of the fourth graders, 71 percent of the eighth graders, and 48 percent of the twelfth graders reported watching three or more hours of television per *day*.

[15] A.G. Farnham, P.T. Wilson, and R.C. Anderson, "A New Focus on Free Reading: The Role of Trade Books in Reading Instruction" in *Contexts of Literacy*. T. Raphael and R. Reynolds, editors (New York, NY: Longman, 1986).

Jeanne Chall, "Literacy: Trends and Explanations," *Educational Researcher* (1983), pp. 3-8.

Richard C. Anderson, et al., *Becoming a Nation of Readers: The Report of the Commission on Reading* (Champaign, IL: University of Illinois, Center for the Study of Reading, 1985).

[16] Dolores Durkin, *Children Who Read Early* (New York: Teachers College Press, Columbia University, 1966).

Shirley Brice Heath, *Ways With Words: Language, Life, and Work in Communities and Classrooms* (Cambridge: Cambridge University Press, 1984).

[17] V. Greaney, "Factors Related to Amount and Type of Leisure Time Reading," *Reading Research Quarterly* (1), pp. 337-57.

Similarly, as shown in Table 4.1, the amount of reading that students reported doing for school was positively related to their reading proficiency. Nevertheless, students do not appear to read much for school. For example, more than half of the high-school seniors reported reading 10 or fewer pages a day for homework and school. Fourth-grade teachers reported that only about half of the fourth graders worked with books of their own choosing on a daily basis, and students were even less likely to report such reading. Only 32 percent of the fourth graders indicated that they read books of their own choosing on a daily basis, and 31 percent reported that they never had this opportunity.

TABLE 4.1

Number of Pages Read Each Day for Homework and School, 1988: Grades 4, 8, and 12

Number of Pages Read	Grade 4		Grade 8		Grade 12	
	Percent	Average Proficiency	Percent	Average Proficiency	Percent	Average Proficiency
5 or fewer	23	221	32	254	31	277
6 to 10	24	234	30	266	25	287
11 to 15	15	237	17	268	17	293
16 to 20	16	232	10	269	12	294
More than 20	22	231	12	272	15	298

Finally, libraries can be a major resource in developing students' reading abilities. In addition to being a source for books, students can obtain reference information and use libraries as a place to study. However, 16 percent of the fourth graders, 37 percent of the eighth graders, and 53 percent of the seniors reported that they never or rarely borrow books from the school or public library.

Discussing Reading and Writing About It

Translating what they read from one medium to another requires students to review and examine what they have read. Thus, both discussing reading and writing about it can serve to improve students' ability to understand text. Writing instruction is not a substitute for reading instruction, nor the converse. However, significant gains in reading ability have been found in a number of studies that used writing activities specifically to improve reading comprehension or that explored similarities between the two processes.[18]

Despite this research evidence, fourth graders spend relatively little time discussing or writing about what they have read, according to their teachers (Table 4.2). Although 45 percent of the fourth graders were asked at least once a week to discuss in pairs or small groups what they had read, 28 percent were never asked to engage in this activity. Eleven percent were never asked to write about what they read. In contrast, the teachers of virtually all of the fourth graders reported that completing workbook and skill-sheet assignments was a frequent (daily or weekly) activity.

Forty-one percent of the eighth-grade students reported that their teachers expect them to frequently discuss what they read, and 38 percent reported writing about what they read on at least a weekly basis. Even for high-school seniors, discussing and writing about their reading is far from universal. Only 63 percent of the twelfth graders reported that their teachers expected them to discuss what they read "a lot," and just 41 percent reported being asked to write about their reading on a weekly basis.

[18] Judith A. Langer and Arthur N. Applebee, "Reading and Writing Instruction: Toward a Theory of Teaching and Learning," *Review of Research in Education 13* (1986), pp. 171-94.

Sandra Stotsky, "Research on Reading/Writing Relationships: A Synthesis and Suggested Directions," in *Composing and Comprehending*, Julie M. Jensen, editor (Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills, 1984).

Lee Galda, "The Relations Between Reading and Writing in Young Children," in *New Directions in Composition Research*, Richard Beach and Lillian S. Bridwell, editors (New York, NY: The Guilford Press, 1984).

TABLE 4.2

Teachers' Reports on Instructional Practices in Reading, 1988: Grade 4

	Percentage of Students	
	Daily/ Weekly	Never
Students talk in pairs or small groups about what they read	45	28
Students write about what they read	59	11
Students complete workbook or skill-sheet assignments	97	1

Students reported discussing their reading at home even less frequently than at school. Although students in the lower grades were more likely than those in the upper grades to report discussing what they were reading with their parents, more than 30 percent of eighth and twelfth graders reported never talking with someone at home about things they read.

Writing Frequently and Understanding the Process

Students learn to write well by frequent practice and by building an understanding of the dynamics of the composing process.[19] Yet, in his comprehensive review of writing research, George Hillocks found that the most common mode of instruction was the least effective — a mode in which the teacher dominates all activity, and students act as the passive recipients of rules, advice, and examples of good writing.[20] One of the strongest findings of his review was that grammar study and emphasis on mechanics and correctness in writing has little or no effect on the improvement of writing.

[19]Donald H. Graves, *Writing: Teachers and Children at Work* (Portsmouth, NH: Heinemann Educational Books, 1983).

[20]George Hillocks, Jr., *Research on Written Composition: New Directions for Teaching* (Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills, 1986).

The NAEP results indicate that students are receiving very little writing instruction at all. As shown in Table 4.3, nearly three-quarters of the eighth graders had teachers who reported spending an hour or less on writing instruction and assistance *each week* — a figure that translates to less than 15 minutes of instruction per day. Just 11 percent of the students had teachers who reported spending two hours or more *each week* (or approximately one half-hour each day) on writing instruction and assistance.

TABLE 4.3

Teachers' Reports on Instructional Practices in Writing, 1988: Grade 8

	Percentage of Students
Time spent each **week** on instructing and helping students with writing	
30 minutes or less	30
60 minutes	42
90 minutes	17
120 minutes	11

	More than half the time	Never or almost never
Teachers give less frequent, lengthy assignments	18	24
Teachers give assignments with several drafts and revisions	36	16
Teachers give assignments that focus on the mechanics of English	59	7
Teachers give frequent short assignments	66	2

Also, the teachers' reports show that the majority of eighth graders are spending most of their limited writing instructional time doing exercises on the mechanics of English (the very approach shown by research to be least effective) or responding to frequent short assignments. Only about one-third of the eighth graders are spending the majority of their time learning about the writing process through writing assignments requiring multiple drafts and revisions (an approach shown by research to be effective).

Although considerable energy has been devoted in recent years to improving writing instruction, teachers often highlight the labor intensive nature of writing instruction and the difficulties associated with teaching writing to large classes of students. Perhaps as a result, students across the nation are not asked to do much writing for school.

At grade 12, half the students assessed in 1988 reported they had written two or fewer papers as part of any school assignment in the six weeks before the assessment. Additionally, most of these papers — at least those written for English or social studies classes — appear to be quite short. Only 60 percent of the eighth and twelfth graders reported being asked to write papers of one or two paragraphs on a weekly basis. A scant 14 percent of the eighth graders and 9 percent of high-school seniors reported weekly writing assignments of three or more pages. Eighth-grade teachers reiterated students' perceptions, reporting that only 45 percent of their students were assigned papers of a paragraph or two on a weekly basis and only 14 percent were asked to write a one- or two-page paper each week.

Mathematics and Science

Much of the recent research in mathematics and science education has centered on developing students' reasoning and problem-solving skills, improving the quality of the curriculum and teaching, allowing for more experience-based learning activities, and incorporating more use of computer technology into classrooms.

Increasing Rigor in the Curriculum

Current concerns about students' low performance in science and mathematics have led to much discussion about both the availability of and enrollment in science and mathematics courses and the ways in which the curriculum might be restructured to better serve the changing needs of our society. Several surveys have indicated that students' instructional time in science is quite limited at the elementary-school level and that high-school enrollments in advanced mathematics and science courses are lower than the general public might expect.[17]

The NAEP data add further support to our growing understanding of instructional and course-taking patterns. As part of the 1986 science assessment, science teachers were asked how much time they spend teaching science to a typical class during a typical week. At grade 3, more than one-fifth of the teachers reported spending less than one hour on science instruction each week and another 49 percent reported only spending from one to two hours per week. Further, only 80 percent of the teachers felt adequately prepared to teach physical or natural science.

At the high-school level, large proportions of students elect to avoid mathematics courses and, to an even greater extent, science courses. Even though the U.S. may retain a larger percentage of students in high school than many other countries, the Second International Mathematics Study found that advanced mathematics course enrollment in the U.S. was only about average.[22] The Second International Science Study found enrollments in advanced science courses in the U.S. to be well below other industrial nations.[23] Despite survey findings from NAEP and other large-scale assessments, consistently revealing that students who have had more

[17] Dorothy M. Gilford, "Data Resources to Describe U.S. Precollege Science and Mathematics Curricula," in *The Science Curriculum*, Audrey B. Champagne and Leslie E. Hornig, editors (Washington, DC: American Association for the Advancement of Science, 1987).

[22] Iris Weiss, *Report of the 1985-86 National Survey of Science and Mathematics Education* (Research Triangle Park, NC: Research Triangle Institute, 1987).

[23] Curtis McKnight, et al., *The Underachieving Curriculum: Assessing U.S. School Mathematics from an International Perspective* (Champaign, IL: International Association for the Evaluation of Educational Achievement: Stipes Publishing Company, 1987).

International Association for the Evaluation of Educational Achievement, *Science Achievement in Seventeen Countries* (New York: Pergamon Press, 1988).

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coursework also have higher achievement levels, even students in academic programs often do not enroll in advanced mathematics and science courses.

In 1986, one-quarter of the eleventh graders assessed were not enrolled in a mathematics course and another one-quarter were taking lower-level courses, such as General Mathematics, Pre-algebra, or Algebra I. Slightly more than half (58 percent) of all eleventh graders reported that they were taking any type of science course at the time of the assessment. Students would have had the opportunity to take advanced courses, such as physics, in their senior year; however, the NAEP findings are reinforced by the results of the 1987 High School Transcript Study, which found that in 1987, 44 percent of graduating high-school students had taken biology and chemistry, while only 17 percent had also completed a physics course.[4]

Eleventh graders participating in NAEP's 1986 assessments were asked to indicate their type of high-school program. Fifty-two percent reported being enrolled in an academic college preparatory program, 38 percent in a general program, and 10 percent in a vocational technical program. The patterns of mathematics and science course taking by program of study are presented in Table 4.4.

As expected, the half of the students who were enrolled in academic programs were more likely to have taken advanced mathematics and science courses, yet even for these students, the percentages remained relatively low. For example, only 61 percent of the eleventh graders in academic programs reported taking Algebra II, and just 10 percent of these students had gone on to take pre-calculus or calculus. Only half had taken both biology and chemistry, and fewer still had also taken physics (9 percent).

[4] Westat, Inc., Preliminary data from the 1987 High School Transcript Study, prepared for the U.S. Department of Education, National Center for Education Statistics, March, 1988.

TABLE 4.4

Mathematics and Science Course Taking by Type of School Program, 1986: Grade 11

	Percentage of Students by Type of School Program		
	Academic	General	Vocational/ Technical
Highest level mathematics course taken			
Pre-algebra	4	29	37
Algebra I	9	24	27
Geometry	15	15	13
Algebra II	61	28	18
Pre-calculus or calculus	10	2	2
Cumulative science course taking			
General science only	3	14	23
Biology only	33	60	61
Biology and chemistry	50	17	6
Biology, chemistry, and physics	9	2	2

Although about half of the high-school students did report that they planned to go on to college, it appears that a number of those enrolled in academic programs were not enthusiastic about pursuing rigorous academic coursework. Research on data from earlier NCES studies such as High School and Beyond clearly links high-school curricular placement with achievement, educational, and occupational aspirations. Yet, it may be that a number of students end up in academic programs almost by default. NELS 1988 found that one-quarter of the eighth graders were still uncertain about the high-school program in which they expected to enroll. Only 29 percent had decided on a college preparatory program. (Of the remaining eighth graders, 18 percent had decided on a vocational program, 14 percent on a general program, and the rest on other types of programs.)

Learning by Thinking and Doing

Effective teaching requires orchestrating a variety of strategies suited to a given instructional setting. However, research in both education and cognitive psychology has indicated the need for some changes in the teaching of mathematics and science.[25] These changes include increasing the use of "hands-on" examples and placing more problems in real-world contexts to help students construct useful meanings for abstract concepts.[26] Table 4.5 provides information on the prevalence of various instructional activities in eleventh-grade mathematics and science classrooms.

If the new types of student-centered, conceptually based instructional activities suggested by researchers were being widely incorporated into classrooms, the NAEP results would paint a portrait of relatively varied instructional approaches involving concrete materials, projects, and group activities. Instead, in mathematics, students at all three grades reported spending considerable time listening to teacher explanations and, at the higher grade levels, watching the teacher work problems on the board. Also, rather sizable proportions of students reported working problems independently either daily or weekly. By comparison, relatively few students said they frequently worked problems in groups, wrote reports, or engaged in projects.

As part of the science assessment, students were asked to what extent they learned science through teacher lectures and demonstrations, compared to how frequently they engaged in "doing science" — for example, discussing the results of experiments, hypothesizing, and interpreting data. Students were also asked to report how often they solved science problems, conducted experiments alone or with other students, wrote up the results of experiments, read articles on science, and presented oral or written reports.

[25] Lauren Resnick, *Education and Learning to Think* (Washington, DC: National Academy Press, 1987).

[26] Thomas Romberg, "A Common Curriculum for Mathematics," *Individual Differences and the Common Curriculum: Eighty-second Yearbook of the National Society for the Study of Education* (Chicago, IL: University of Chicago Press, 1983), p. 134.

Ronald J. Rossmiller, John E. Pernick, and Robert E. Yager, *Teachers in Exemplary Programs: How Do They Compare?* (Washington, DC: National Science Teachers Association, 1983).

TABLE 4.5

Overview of Instructional Practices in Mathematics and Science, 1986: Grade 11

	Percentage of Students	
	Daily/ Weekly	Never
Mathematics		
How often do you...		
Watch your teacher work problems on the board	94	5
Use a mathematics textbook	94	5
Listen to your teacher explain a lesson	94	5
Work problems independently	93	5
Work problems in small groups	27	59
Make reports or do projects	6	87
Science		
How often does your teacher...		
Lecture	88	8
Demonstrate a scientific principle	77	10
Ask you to suggest hypotheses	53	25
Ask you to read a science textbook	70	18
How often do you...		
Do experiments with other students	53	18
Read articles on science	35	39
Do experiments alone	29	46
Write up experiments	34	41
Do an oral or written report	15	52

Although seventh- and eleventh-grade students who reported classroom activities that were challenging and participatory were likely to have higher science proficiency, the instructional activities reported most often by students were listening to the teacher lecture, watching teacher demonstrations, and reading science textbooks. Further research documents that rote memorization is a central feature of current science textbooks, and over half the students at all three grades stated that they read these texts daily or weekly.[1] High-school students were more likely than seventh graders to report that their teachers lectured on a daily basis; this mode of instruction predominated at both grades 7 and 11, while other kinds of learning opportunities were relatively rare.

It is particularly disappointing that approximately half of the seventh graders and nearly one-quarter of the eleventh graders reported never being asked to suggest hypotheses or interpret data as part of their science instruction. At grade 11, between 41 and 52 percent of the students reported that they never conducted independent science experiments, wrote up the results of experiments, or did oral or written reports for science class.

Using Technology and Laboratory Equipment

As the development of students' problem-solving and reasoning skills are central goals in mathematics and science education, the calculator and especially the computer are viewed as ways to improve the learning of mathematical and scientific ideas, including modeling, matrix algebra, statistics, and applications in various fields.[2] Many of the reports urging instructional reforms in these subjects have recommended that technology be integrated into mathematics and science instruction, enabling students to engage in more sophisticated computations and explorations.[3]

Despite this view, NAEP results show that technology is far from widespread in American classrooms. Most students have calculators available in the home, but relatively few have access to calculators in school. In 1986, only 15 percent of the third graders, 21 percent of the seventh graders, and 26 percent of the eleventh graders reported that their school had calculators for use in mathematics class.

[1] Robert E. Yager, "The Importance of Terminology in Teaching K-12 Science," *Journal of Research in Science Teaching* 20(6) (1983), pp. 577-588.

[2] Conference Board of the Mathematical Sciences, *New Directions for Mathematics* (Washington, DC: Conference Board of the Mathematical Sciences, 1985).

[3] National Council of Teachers of Mathematics, *Curriculum and Evaluation Standards for School Mathematics* (Reston, VA: National Council of Teachers of Mathematics, 1989).

Although NAEP data show considerable increases in the percentages of students who have access to computers to learn mathematics, still only about half of the students assessed in 1986 reported such availability. Students who reported that they had used a computer for problem-solving tended to have higher mathematics proficiency than those who had not. It should also be noted that the trend assessment data suggest that computer access has been relatively equitable across gender and racial/ethnic groups.

In science, laboratory experimentation and other experience-based activities are thought by most educators to be an integral part of learning, as they enable students to study the subject in a manner consistent with the practice of science.[20] Unfortunately, many science teachers at grades 7 and 11 reported that they had no laboratory facilities available for these kinds of activities (Table 4.6).

Teachers' Reports on Access to Laboratory Facilities, 1986: Grades 7 and 11

	Percentage of Teachers Responding "Yes"	
	Grade 7	Grade 11
Do you have access to a general purpose science laboratory for your teaching?	46	45
Do you have access to a specialized science laboratory for your teaching?	20	64

Slightly less than half of the teachers in either grade reported that they had access to a general purpose laboratory for use in teaching science, and less than one-fifth of the seventh-grade teachers had access to more specialized facilities (i.e., a Biology, Chemistry, or Earth Science

[20] Wayne W. Welch, "A Science-Based Approach to Science Learning," in Rezba, R. Matthies, Brad T. Hoekstra, and Pamela Lutz, editors (Washington, DC: National Science Teachers Association, 1984).

laboratory). Fewer than two-thirds of the eleventh-grade teachers had access to a specialized laboratory. Without access to laboratory facilities, it is perhaps not surprising that so few of our students understand the tools and methods of science.

U.S. History, Civics, and Geography

As in English, mathematics, and science, a large volume of research in history, civics, and geography education has focused on ways to improve curriculum and instruction to facilitate student learning. Work is being done to explore how to make these important curriculum areas more accessible and understandable for students and how to increase students' ability to reason effectively about the events that shaped our country and the issues that face it today.

Starting Early

In *First Lessons*, then U.S. Secretary of Education William Bennett called for major reform in the elementary social studies curriculum. He recommended that "social studies" as presently constituted should be transformed to teach the knowledge and skills needed for life in a democratic society through the interrelated disciplines of history, geography, and civics.[31] Although his language and sentiment appear similar to that of our new national goal, students still seem to study little U.S. history and civics in elementary schools.

In 1988, about half of the fourth graders did report receiving daily instruction in social studies. However, the subject is typically given little time during the school day relative to reading and mathematics.[32] Further, in most states and schools, formal instruction in U.S. history does not begin until the fifth grade, and world history is left aside until the middle-school or junior-high years.[33] Formal instruction in U.S. government and politics is even less

[31] William J. Bennett, *First Lessons: A Report on Elementary Education in America* (Washington, DC: U.S. Department of Education, 1986).

[32] Iris Weiss, *Report of the 1985-86 National Survey of Science and Mathematics Education* (Research Triangle Park, NC: Research Triangle Institute, 1987).

[33] National Commission on Social Studies for Early Childhood and Elementary School Children, *Preparing for the 21st Century: A Report from the NCSS Task Force on Early Childhood/Elementary Social Studies* (Social Education, 51-1, 1987).

prevalent in elementary and middle schools, as is formal instruction in geography. However, whereas most students take a high-school course in U.S. government or civics, geography course taking is much less prevalent. In a survey conducted by the Council of Chief State School Officers, only 18 percent of the states reported that they required students to take a geography course before they graduated from high school.[1]

As part of the NAEP assessments, fourth graders were asked about the U.S. history and civics topics they had studied "a lot" or "not at all." The U.S. history topics that appeared to be most commonly taught pertained to the American Indians, inventors, the Pilgrims, and explorers. Such topics as the Revolutionary War, the Civil War, and settlement of the West were taught less often, with more than one-third of the students reporting that they never studied these topics. The most prevalent civics topics studied appeared to be the community, presidents, citizens' rights, and how laws are made. More than half of the fourth graders reported never having studied judges and courts and more than one-third reported never having studied about elections and voting.

Once behind in the study of these curriculum areas, students do not seem to catch up to the broad range of topics to be covered until grade 12, if at all. Eighth and twelfth graders were also asked about the topics they had studied, and their responses are displayed in Table 4.7.

Even at the eighth-grade level, large proportions of students had not studied many of the U.S. history and civics topics listed. For example, between 38 and 50 percent reported they had never studied the Reconstruction era, the First or Second World War, and the period from 1945 to the present. Fifteen percent or more stated they had never studied about state and local government, the court system, the principles of democratic government, or other forms of government.

[1] Council of Chief State School Officers, *Geographic Education and the States* (Washington, DC: Council of Chief State School Officers, 1988).

TABLE 4.7

Topics Studied as Part of U.S. History, Civics, and Geography Instruction, 1988: Grades 8 and 12

	Percentage of Students			
	Grade 8		Grade 12	
	A lot	None	A lot	None
U.S. History				
Exploration	40	8	27	7
Colonial America	46	11	39	6
Revolutionary War	58	6	49	3
Civil War	51	14	56	3
Reconstruction	21	42	32	12
Industrial Age	—	—	36	7
First World War	25	38	46	5
Great Depression	—	—	51	5
Second World War	21	43	44	8
1945 to present	13	50	28	14
History of minorities and women	—	—	21	7
Civics				
U.S. Constitution, Bill of Rights	56	4	55	3
Congress	42	8	45	4
Court system	30	18	39	6
President and Cabinet	39	12	40	5
Political parties, elections, voting	44	9	45	4
State and local government	30	15	36	6
Principles of democratic government	20	28	32	9
Other forms of government	21	20	26	8
Geography				
Locations	—	—	29	17
Geographic skills and tools	—	—	19	28
Cultural geography	—	—	7	51
Physical geography	—	—	17	36

The — symbol indicates that the question about this topic was not asked at the designated grade.

By grade 12, almost all students appeared to have received at least some instruction on the U.S. history and civics topics identified here. Still, 12 percent of the high-school seniors reported they had never studied the Reconstruction era, and 14 percent stated they had not studied the period from 1945 to the present. In civics, 9 percent of the students at grade 12 had not studied the principles of democratic government and a comparable percent had not studied other forms of government. As common sense would suggest, NAEP results showed that students who reported "a lot" of study of U.S. history and civics topics also had higher proficiency in those subjects. Yet, it appears that many students are not given the opportunity to begin studying these subject areas until later in their school careers. With a solid start in elementary school, students would have the opportunity for more depth and breadth of study.

Interpreting and Integrating Information

There is evidence that the use of multiple sources and literary historical narratives helps students to develop an understanding of history as an interpretive enterprise.[5] Beginning in elementary schools, children can learn about the legends of Paul Bunyan and Johnny Appleseed, hear true stories of Revolutionary era heroes like Benjamin Banneker and Nathan Hale, and learn how women like Harriet Beecher Stowe and Emily Dickinson helped shape our nation.[6]

Across the grades, classrooms should have a wide array of materials available for students, including primary and secondary texts, biographies, autobiographies, historical fiction, and maps and globes.[7] Such resources can be used to encourage lively debates, investigate comparisons and cause-effect relationships, and connect places, persons, and events. Students can also be asked to write essays, produce research-based papers, evaluate sources of information, draw conclusions, and construct logical arguments.

[5] Matthew T. Downey and Linda S. Levstik, "Teaching and Learning History: The Research Base," *Social Education* 52 (1988): pp. 336-42.

Linda S. Levstik and C.C. Pappas, "Exploring the Development of Historical Understanding," *Journal of Research and Development in Education* 21 (1987): pp. 1-15.

[6] William J. Bennett, *First Lessons: A Report on Elementary Education in America* (Washington, DC: U.S. Department of Education, 1986).

[7] National Commission on Social Studies in the Schools, *Charting a Course: Social Studies for the 21st Century: A Report of the Curriculum Task Force of the National Commission on Social Studies in the Schools* (November 1989).

To foster the types of learning desired, teachers will need to act more as facilitators of learning and students will need to become active doers and thinkers in the classroom rather than simply passive recipients of information.[38] Some examples of these alternative modes of instruction include small-group problem solving and peer tutoring, as well as collaborative and student-centered learning.[39]

Yet, information from NAEP and other studies suggests that social studies classes tend to be teacher-directed, with most information coming from textbooks, lectures, and films.[40] Further, the emphasis on reasoning skills has declined.[41] When eighth- and twelfth-grade students were asked how often certain instructional activities occurred in their U.S. history and civics classes, their responses were remarkably consistent — not only across subject areas, but also across grade levels. Table 4.8 offers a summary of instructional activities used in U.S. history and civics classrooms at the twelfth-grade level.

In both subjects, from 80 to 90 percent of the eighth and twelfth graders reported daily or weekly use of textbooks and discussion. About 70 percent reported being asked to write short answers to questions and to take tests or quizzes this often, with testing more prevalent in both subject areas at the twelfth grade. One- to two-thirds of the students at grades 8 and 12 reported being asked daily or weekly to give talks about what they were studying, memorize materials they had read, and read material from sources beyond their textbook.

[38] Lauren Resnick, *Education and Learning to Think* (Washington, DC: National Academy Press, 1987); John D. Bransford and Nancy J. Vye, "A Perspective on Cognitive Research and its Implications for Instruction," in *Toward the Thinking Curriculum: Current Cognitive Research*, Lauren B. Resnick and Leopold E. Klopfer, editors (Washington, DC: Association for Supervision and Curriculum Development, 1989).

[39] Elizabeth Cohen, *Designing Group Work: Strategies for the Heterogeneous Classroom* (New York, NY: Teachers College Press, 1986).

Richard Slavin, "Ability Grouping and Student Achievement in Elementary Schools: A Best-Evidence Synthesis" (Baltimore, MD: Johns Hopkins University, National Center for Effective Elementary Schools, 1986).

F.M. Newmann and T.A. Thompson, *Effects of Cooperative Learning on Achievement in Secondary Schools: A Summary of Research* (Madison, WI: National Center on Effective Secondary Schools, 1987).

[40] F.R. Smith and K.M. Feathers, "Teacher and Student Perceptions of Content Area Reading," *Journal of Reading*, 1 (1983): pp. 348-54.

[41] J.P. Shaver and O.L. Davis, Jr., and S.W. Helburn, "The Status of Social Studies Education: Impressions from Three NSF Studies," *Social Education*, 43 (2) (1979): pp. 150-53.

TABLE 4.8

Overview of Instructional Practices in U.S. History and Civics, 1988: Grade 12

	Percentage of Students			
	Daily/ Weekly		Never	
	U.S. History	Civics	U.S. History	Civics
How often does your teacher ask you to...				
Read material from your textbook	90	87	2	3
Discuss and analyze the material you have read	84	84	3	3
Discuss current events		80		3
Take a test or quiz	77	78	1	1
Write short answers to questions	71	68	5	6
Use maps or globes	49		8	
Give talks about what you are studying	47	51	19	18
Read extra material not in your textbook	39	45	13	13
Watch movies, videos, and filmstrips	36		6	
Work on a group project	15	17	25	24
Write a report of three or more pages	13	12	15	21

The "—" symbol indicates that a particular question was not asked in this subject area assessment.

Despite their apparent efficacy, working on group projects and writing reports of three or more pages seem to be relatively rare practices in U.S. history or civics courses. Activities of this nature hold promise for helping students to develop coherent understandings, but fewer than 17 percent of the students reported that these instructional approaches were used at least weekly in their classes. One-quarter of the high-school seniors reported they were never asked to work on a group project in their U.S. history or civics class, and 15 to 21 percent stated they were never asked to write a report of three or more pages in length.

In summary, it appears that the bulk of classroom instruction requires students to watch and listen to their teacher, read from their textbooks, and provide short written answers to questions. According to both students and teachers, activities that can foster higher-level thinking — such as communicating in writing, hypothesizing, interpreting data, working in small groups to discuss material or work problems, and giving oral reports — are rare in American classrooms. It should not be surprising, then, that students' reasoning skills are limited.

Supporting Education in the Home

Parents can play a critical role in strengthening their children's education by participating in their learning and by reinforcing the efforts of teachers and schools.[12] For example, they can encourage students to pursue advanced course work, to invest significant amounts of time in their homework, and to devote more time to reading than to television. An interest in reading and learning can be fostered by reading aloud to children; holding family discussions about reading materials, school work, and current events; and encouraging frequent trips to the library to gather more information about interesting topics.

Extra studying helps children at all levels of ability, and homework can boost the time spent studying.[13] Effective homework assignments do not just supplement the classroom lessons; they also teach students to be independent learners. Homework gives students experience in following directions, making judgments, working through problems alone, and developing responsibility and self-discipline.

In Table 4.9, twelfth graders' average proficiency in the subjects assessed in 1988 is analyzed according to the amount of time spent on homework. The results show a consistent, positive relationship between proficiency and the amount of time spent on homework. The startling fact remains, however, that more than two-thirds (71 percent) of the high-school seniors typically do one hour or less of homework each day.

[12] Carnegie Council on Adolescent Development, *Turning Points: Preparing American Youth for the 21st Century* (New York, NY: Carnegie Corporation of New York, 1989), pp. 36-39.

[13] James P. Comer, "Home, School, and Academic Learning," in *Access to Knowledge: An Agenda for Our Nation's Schools*, John I. Goodlad and Pamela Keating, editors (New York, NY: College Entrance Examination Board, 1990), pp. 23-42.

The Harvard Education Letter, *Parents and Schools* (Cambridge, MA: Harvard University Press, Newsletter, December 1988).

U.S. Department of Education, *What Works: Research About Teaching and Learning*, second edition (Washington, DC: U.S. Department of Education, 1987).

TABLE 4.9

Average Proficiency by the Amount of Time Spent on Homework Each Day, 1988: Grade 12

	Percentage of Students	Reading (0-500)	Writing (0-400)	U.S. History (0-500)	Civics (0-500)
Time Spent Doing Homework Each Day					
None assigned	9	269 (2.6)	210 (3.3)	281 (2.0)	281 (2.4)
Did not do	9	281 (2.4)	232 (2.9)	292 (2.5)	285 (3.2)
1 hour or less	53	288 (1.8)	225 (1.7)	296 (1.4)	298 (1.8)
2 hours	19	293 (1.6)	232 (2.5)	299 (1.6)	302 (1.6)
More than 2 hours	10	296 (2.3)	236 (2.8)	302 (3.5)	304 (2.4)

Summary

The problems associated with the low levels of academic achievement in our country are obviously deep-rooted and complex, and the views as to what must be done are, therefore, numerous and varied. This chapter placed the NAEP assessment results in the context of what research tells about effective approaches to teaching and learning. For example, there is evidence that students can improve their reading achievement by reading more frequently in and out of school and that they can increase their comprehension of texts through further discussion and written work. Similarly, students can improve their writing skills by writing more frequently and by developing an increased understanding of the process. Despite the fact that these are common-sense approaches to improving achievement in English and that they are well documented by research, students are not asked to read or write much for school. Home support for literacy does not appear to be much better.

Students' opportunity to learn mathematics and science appears to be sharply curtailed by their elective decisions not to take advanced coursework. In addition, science receives little attention in elementary schools. A growing body of research documents that hands-on activities, problem solving, use of technology, and student-centered learning are the most effective ways to improve students' achievement and sustain their interest in these subjects. However, the coursework that students do take appears to be dominated by teachers lecturing and relying on textbooks, rather than by students exploring complex problems and doing science.

Students' opportunity to learn history, civics, and geography also appear limited by the lack of attention given to these areas in elementary schools. Although most students study these areas as they progress through school, with the exception of geography, the slow start affects later achievement levels. Even by the eighth grade, almost half of the students have studied little U.S. history past the Civil War. Instead of using the varied instructional activities suggested by research — such as asking students to use an array of materials and to think about relationships and connections — the most frequent approaches in history, civics, and geography classrooms depend heavily on textbooks, lectures, and films.

If we are to raise the existing levels of student achievement in English, mathematics, science, history, and geography, students need the opportunity for adequate instructional time in those subjects. To give students a good start at the younger grade levels, the amount of class time spent on reading, writing, mathematics, science, and social studies instruction should be increased to the greatest extent possible. At the upper grades, and particularly at the high-school level, more students need to be encouraged or required to pursue advanced coursework in these curriculum areas.

While it seems critical that the amount of time devoted to learning in the core subjects be increased, this alone is not enough. It is perhaps even more important to increase the quality of that time. Numerous research studies on student learning have suggested new ways to increase the efficiency of instructional time. Yet, the prevalent approaches in today's classrooms are the same ones that have always predominated — lectures and textbooks. By adopting more student-centered approaches (written reports, oral presentations, problem solving, projects, and collaborative group work) teachers can encourage responsibility, increase interest, enable students to see the connections between the material they are learning and what they already know, and foster higher-reasoning skills.

Finally, parents and their children need to understand the importance of working hard to improve educational achievement. Students need to take more challenging courses, spend more time on homework and learning outside of school, and devote more time to reading instead of watching television. Parents can reinforce the efforts of schools by encouraging students to pursue these activities and by monitoring how children spend their time. Parents are children's first and most important teachers, and they need to sustain this role throughout students' school years by showing a high degree of interest and involvement in their children's studies and learning.

It will be very difficult to improve overall achievement if parents, children, and the general public remain generally apathetic about the need to improve education in our country. The ability to achieve our national goal of improved academic achievement for all students will require a concerted effort by all Americans, whether they be policy makers, educators, parents, or concerned citizens exercising their rights as voters and community members. The low levels of academic achievement in our country today have failed to improve appreciably since the publication of *A Nation at Risk*, despite the education reform movement. Reform, particularly of the major sort currently underway, takes time to implement and must proceed in a systematic and sustained fashion; however, efforts to improve achievement levels and to help all students learn to use their minds well must be greatly hastened if we are to achieve our goal of increased preparedness for the complexities of life in the 21st century.